SCIENTIFIC AMERICAN

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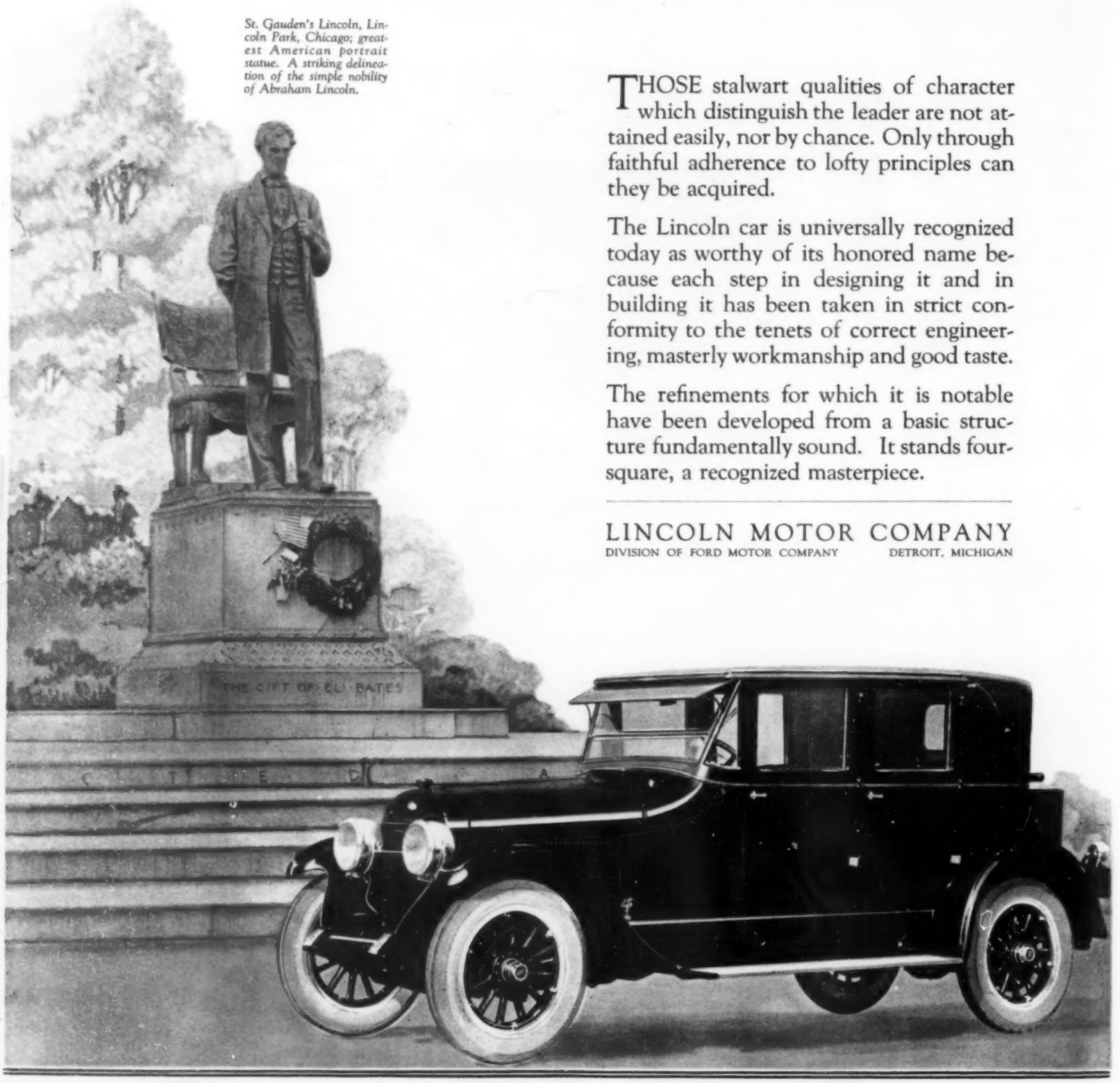

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With the Editors

WE DRAW particular attention to the story on pages 228 and 229 of this issue, describing the mechanical side of Morris Gest's brilliant production of "The Miracle." This is one of a series of spectacular engineering stories of the stage; previous numbers were the description of the Earl Carroll Theater, and the account of the production of "Johannes Kreisler." Other stories of this character will appear from time to time, as the managers put out material worthy of such treatment. Our procedure for these theatrical stories is to send the artist to the theater, and let him live there, on and off the stage, in and out of the audience, during the performance and during the periods of preparation, until he is thoroughly familiar with the whole apparatus. Then he goes back to his studio and makes a working sketch for his big drawing. This he puts before the stage manager and various other members of the theater staff, and before us; and after all possible corrections and suggested improvements have been made, he goes ahead with his final drawing. About this, with the artist's collaboration, we write the text and the captions, giving what amounts to a first-hand account of this interesting field of engineering, so wholly neglected by many of our contemporaries.

OUR regular readers will recall, a year or so ago, a series of three articles by Guy E. Mitchell, of the United States Geological Survey, detailing the adventurous side of the work of the men who go out into the field with transit and notebook and bring back the material for the wonderful topographic maps, which are rapidly coming to cover the whole country. Several months ago, the daily press gave much space, for a few days, to the dangerous position, the possible loss, and the ultimate safety of a party of Government surveyors who had undertaken to shoot and map the Grand Canyon of the Colorado. From Mr. Mitchell's fluent pen we now have an authoritative tale of just what happened to this party, and why; just what they were doing in the canyon; just what their adventures were and how narrow was their escape from disaster.

ANOTHER very interesting tale comes to us from well, we don't just know whether it comes from the Arizona desert or from the mountains of the moon. The point is to be found mainly in the celebrated "meteor crater" of Arizona, a huge hole in the earth with a raised rim around it. For some time controversy raged as to the method of formation of this crater. Was it an extinct volcano, of unprecedented size for terrestrial volcanoes; or was it the result of a mighty blow dealt the earth by a huge meteoric wanderer? At an early stage of the argument the great similarity between Meteor Crater and the thousands of craters on the moon was noted; and orthodox science argued that since the moon craters were obviously volcanic, Meteor Crater was volcanic, too. The owner of the Arizona specimen now tells us that the shoe is on the other foot; that he has proved his crater to be an impact crater, and that from this it follows that the astronomers must grant that all the little pot-holes on the moon have been shot into our satellite by meteoric projectiles. He presents his interesting arguments, with a wealth of interesting pictures, in an early issue; and while they have not yet been accepted by orthodox science, there seems excellent reason to anticipate that they may be.

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SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

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Vol. 130, No. 4. Published monthly. Entered as second-class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

Price, 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year. postage prepaid.

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ELECTRICAL engineers are perpetually puzzling their heads over the necessity of carrying high tension currents through cables under circumstances where proper insulation is at once abnormally difficult and unusually essential. Particularly when cables must go underground, they must be placed together, numerous cables in a single conduit; and the insulation problem becomes the controlling aspect of the situation. The most effective insulation that has been found for use in such places is of paper. How the cables and insulation are made, and how the paper is wound around the cables, forms the subject of an interesting article which is scheduled for the May number.

OF THE numerous contributing editors listed on this page, none is more active than Dr. Luckiesh. Dr. Luckiesh and his laboratory have found out more things about light and lighting than an earlier generation would have supposed remained to be found. Of utmost importance, for instance, is the investigation of the manner in which inadequate illumination not merely increases the difficulty of seeing and makes us work harder to see, but actually makes us see more slowly, so that, if our work involves the use of our eyes, we get less done in a given time under poor conditions of illumination. This is another of the features which we can promise for an early issue.

WE CAN'T promise it more definitely than that, because, while the completed manuscript lies before us as we write, we never know until the last gun fires what we shall have in the way of last-minute stuff, and what will as a result be forced to wait another month. The Teapot Dome story in this issue is a case in point; obviously it could not have been included in the original plans for the April number, which are formulated around the first of February; obviously, then, something had to go out to let it in. So when something that has been mentioned in this column does not appear promptly, don't get impatient over the delay; we have the story, or we wouldn't mention it here.

ACCORDING to present plans—which have at least two weeks to go astray in—the next installment of the traffic series will be made in Connecticut to an even larger extent than the present one. Commissioner Stoeckel and his staff have put a lot of gray matter into the consideration of how to prevent accidents; and their first and foremost conclusion is that you can't prevent them, unless you have a vast fund of information as to how, and when, and where, and why, they occur. A system has accordingly been installed in the Nutmeg State under which every accident gets reported in full to the commissioner's office, and then gets put through a statistical mill of extraordinary efficiency, calculated to bring out with the utmost clarity its relations with other accidents and with the matter of prevention. As a result of the intelligent compilation and intelligent use of these statistics, a large number of places throughout the State at which accidents were formerly frequent have been identified and analyzed in search of their bad features. This has led not merely to the reduction of accidents at these points, but to recognition of the general features of lighting and road-surface that promote accidents. We shall exhibit the system under which all this has been done.

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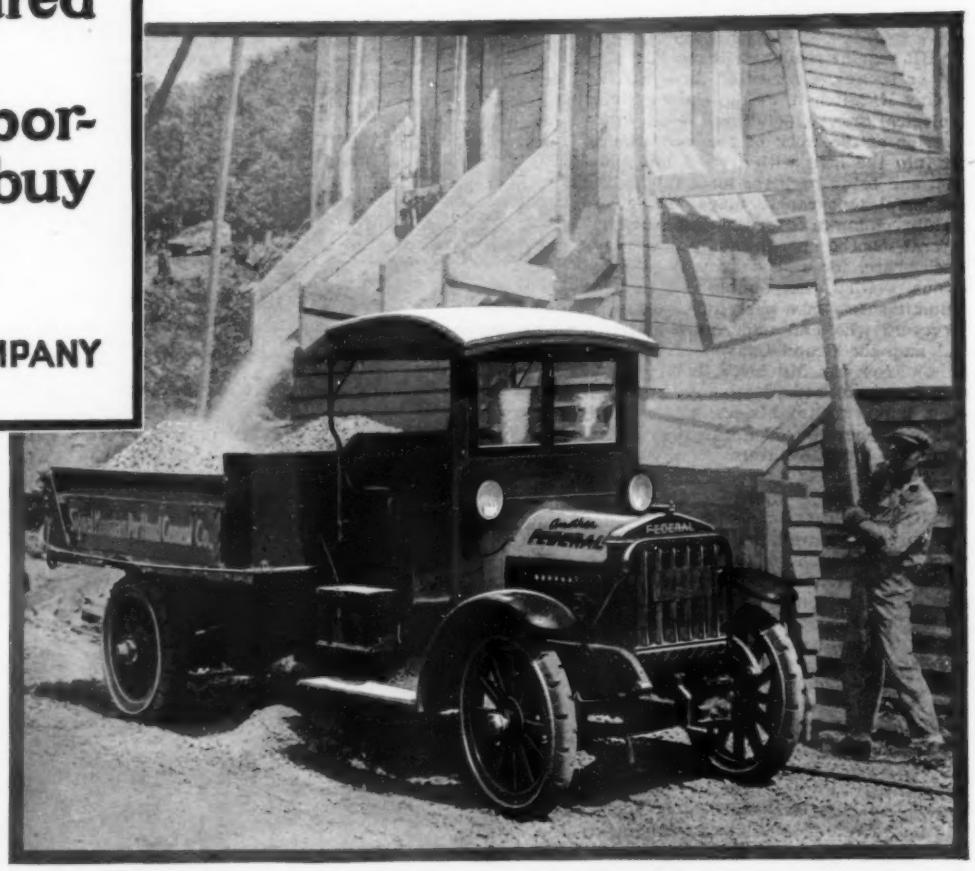

Prices of Federal Trucks

1-Ton	$1675	7-Ton	$5000
1½-Ton	2150	Light Duty Tractor	3200
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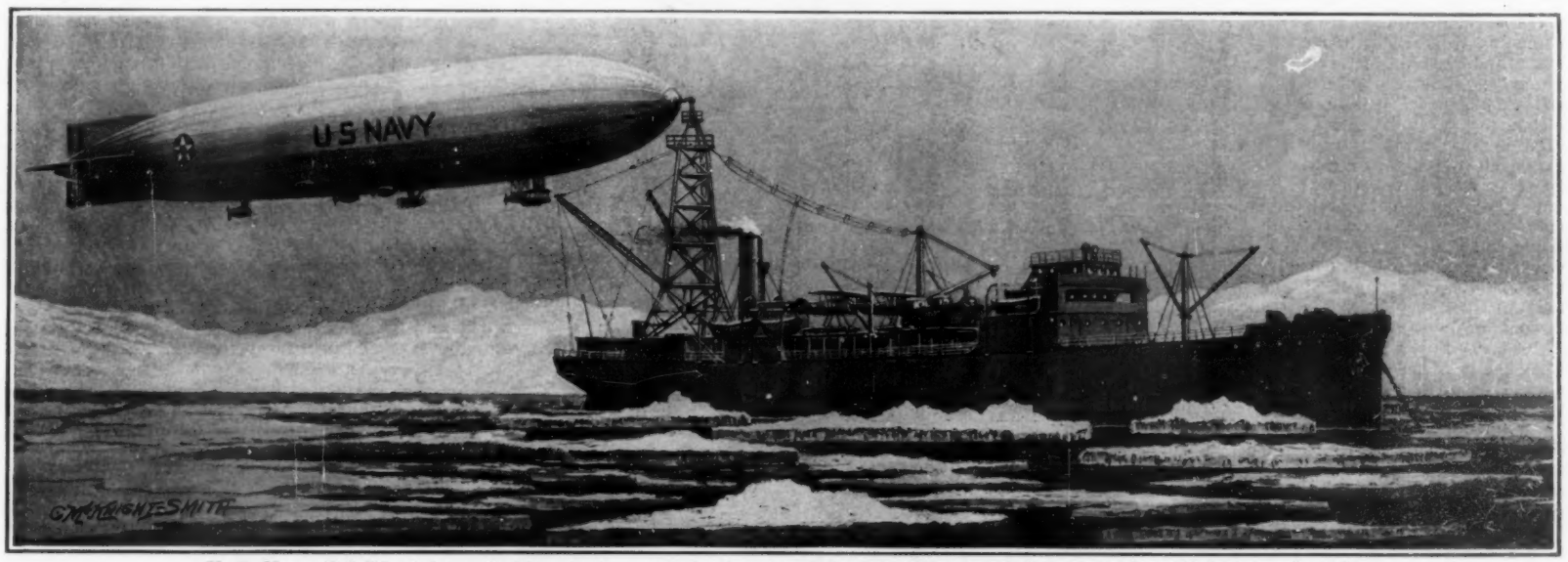
SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, APRIL, 1924



U. S. Navy dirigible "Shenandoah" swinging at the tall and sturdily constructed mooring mast of a 450-foot supply ship

The Mooring Mast is the Thing

By J. Bernard Walker

ONCE launched in the air, the airship should stay there, returning to its hangar only when major repairs or general overhauling and repainting are necessary. The hangar should be regarded as having the same relation to the airship as the drydock has to the ship of the sea. Foremost among the perils to which a seagoing ship is exposed is that very *terra firma* upon which she was built. If her great fabric so much as touch the coast or the sea bottom, it is liable to be badly broken or wrecked beyond repair. When she enters port she makes fast to a mooring, where she may swing head to tide or wind; or she is moved slowly and gently to her pier, and protected from rude contact with its masonry by carefully disposed fenders.

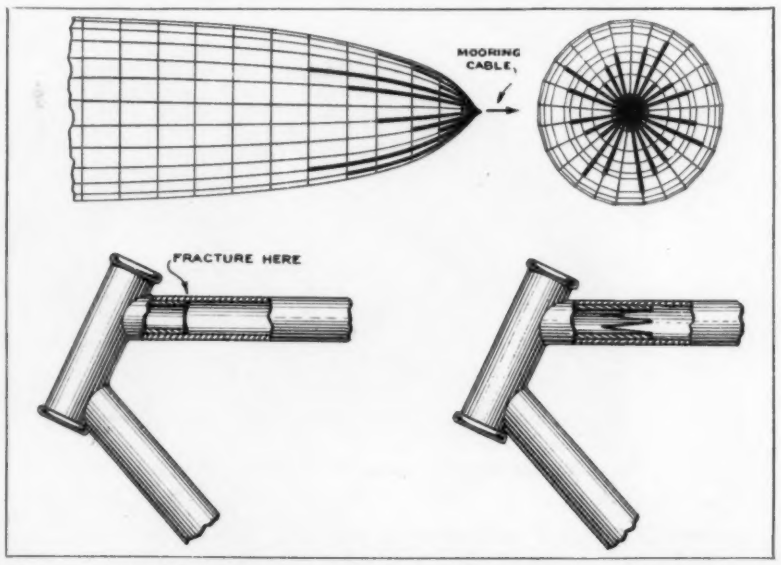
If mother earth is dangerous to the seaship, it is doubly so to the airship. If contact with the unyielding ground is perilous to the frail shell of the ship, it is immeasurably more perilous to the delicate shell of a dirigible; as the loss of many of the early Zeppelins so clearly proved. More than one of these was destroyed as it was entering its shed—a puff of wind serving to swing the hull against the doorway and break its back. Others were lost when they came to earth, during a trip, for repairs or replenishment of fuel.

These disasters, and they were frequent, proved that moorings were as necessary for the ship of the air as they were for the ship of the sea, and that it was as foolish to ground an airship upon the land at the end of a voyage as it would be for a skipper to run his ship ashore every time he entered port.

As long ago as 1910 the writer drew attention in the SCIENTIFIC AMERICAN to these self-evident facts and suggested that the only rational way to handle the airship, between cruises, was to moor it to a rigid and lofty mast. The suggestion was first put into practice several years later by the Vickers, Maxim firm, and its practicability was proved when airships in England remained moored in the open for several weeks on end, and rode out gales in which the wind rose at times to 50 and even 60 miles an hour.

The fact that a 70-mile gust tore out the nose-cap of "Shenandoah" proves nothing against the mooring mast. What it does prove is that we must not apply a heavy concentration of stress at a single point in the delicate shell of an airship, unless provision is made for the immediate distribution of that stress throughout a large contiguous area of the hull. It was, in part, the omission to do this that caused the failure. The nose-cap is a cone of metal plate, which stood up to its work. To this were riveted the converging ends of the relatively light longitudinal girders. These tore apart just beyond the nose-cap. If there was to be a break it was certain to come just where it did.

Those of us who rode the bicycle in the early days of its development will remember how frequently the diamond frame failed, by bending or fracture, an inch or so back of the steering post. Connection between frame and post was made by inserting a short stub-end of tubing in the frame and brazing the whole together. The fracture always came at the point where the stub finished. The *sudden* decrease in section was an invitation to fracture. The end of the stub was tapered into four fingers of diminishing width. There was no longer a sudden reduction to section; the resistance to bending stress was distributed further along the tube; and breakages ceased.



Lower drawing shows how breakage of bicycle frames was prevented by tapering off the section of the inner reenforcement. The upper drawing shows same principle applied in distributing the pull of mooring cable by light cables or wires, attached at 24 points in the first 75 feet of the ship's hull

Now like treatment would produce like results in this mooring problem. Distribution of stress could be secured by leading light cables or wires of plough steel from the nose-cap along and within the longitudinal girders and attaching them to the girders at the successive circular frames. Four cables should lead to the first ring, four to the next, and so on until the sixth ring was reached. By spacing the points of attachment at 90 degrees around each ring, the pull of the mooring cable would to distributed, *evenly*, over the first 75 feet of the ship.

To ensure immediate and equal transmission of stress, the cables, before insertion, should be stretched to just beyond the elastic limit and given a permanent set. Each should have a turnbuckle at its mid-length, and all of the cables, or wires, should be set up to the same tension.

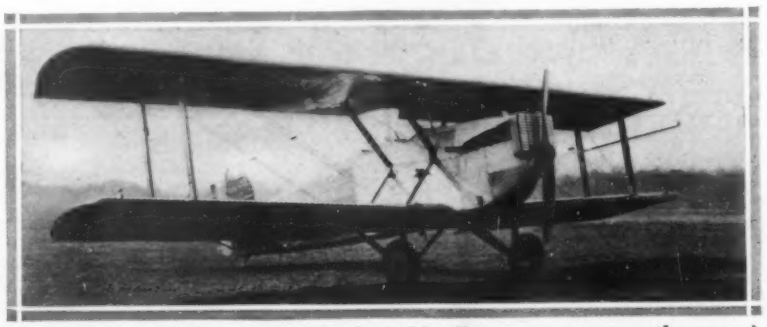
(*Continued on page* 281)

Flying Around the World

The Route Laid Down for the American Fliers Who Will Attempt Circumnavigation

By Lieut. Corley P. McDarment

THE first canoe was undoubtedly tried out in a small pond before inter-island trips were attempted; the first steamboat oozed up and down sheltered rivers a long time before an attempt was made to take it across the ocean. And the airplane? It is a short time even in the modern world of speed since Dec. 17, 1903, when the Wrights made a duration flight of 59 seconds, a long distance flight of 852 feet, broke an altitude record by ascending to a height of 20 feet, and sped over the ground at the rate of 10 miles an hour in their first airplane.

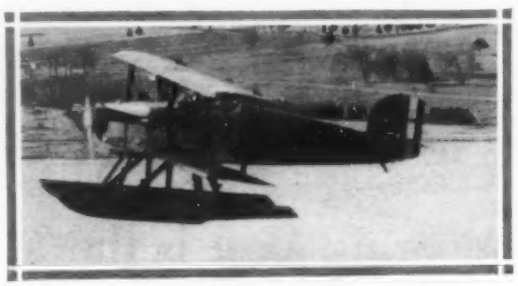


The Douglass World Cruiser, with wheeled landing-gear, at rest on the ground

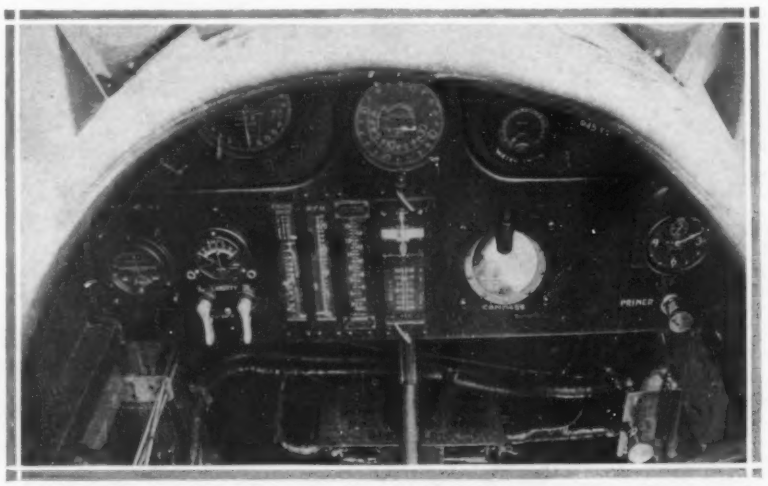
Gradually and often tragically all of these records have been broken. Faster and faster have airplanes speeded, more and more reliable have the motors become, until now aviators firmly declare that a flight around the world is possible and to prove the matter the United States Army Air Service will start a fleet of four airplanes on a journey around the world April 1, 1924. This will not be the first attempt to encircle the globe by air. The intrepid Major Blake of England started on such a journey in 1922 and traveled the route from London to Calcutta where illness prevented his going further and his two comrades who tried to continue the flight were forced down by engine trouble in the Bay of Bengal where they floated for three days on the wreckage of the seaplane before being picked up. Several things have happened in aeronautics since 1922, notably an endurance record of 37 hours and a long distance flight of 2700 miles across the continent by the Air Service of the U. S. Army. The airplanes that start across the oceans on the flight around the world will have, embraced in their manufacture, all the skill and experience learned on these record flights, so that dangers of failure will be reduced to a minimum. It is generally agreed that the only thing that will prevent the success of the flight is the weather.

The airplane that will be used on the big flight is called the Douglass World Cruiser, and designated by the symbol D-WC. It measures 50 feet from tip to tip, 35 feet and 2 inches long and stands 14 feet high. It is a biplane type and both wings are of the same span. The wings are 7½ feet deep and the gap between them is exactly 8 feet; the lower wing has a 2 degree dihedral, but the upper one has none, and both are set with 3 degrees incidence, or angle of attack. There is no stagger or sweepback. The total supporting surface is 700 square feet, which may be loaded up to about 15 pounds per square foot but normally it will be loaded at about 12 pounds. The total weight of the airplane fully loaded and carrying pontoons for water landings is 9600 pounds, but with pontoons off, the weight is 1000 pounds less. The wheeled landing-gear weighs 364 pounds, and when flying as a seaplane this extra weight may be carried as fuel or other supplies. The useful load that can be carried is approximately 5000 pounds and if this weight be split up into a crew allowance of 360 pounds; gasoline, 3600 pounds; oil, 375 pounds and water, 84 pounds, it will be seen that with the Liberty motor, with which it is powered, using 20 gallons of gasoline an hour, a sustained flight can be made of 30 hours during which 3000 miles could be covered. The speed of the plane has a range of 85 to 110 miles an hour. No distances between stops, however, are so great on the route around the world that a sustained flight of this duration would be necessary, so the fuel capacity has been cut down in the planes to 360 gallons, or about 2160 pounds. A special 1923 model Liberty motor will be used that can produce 420 horsepower, but when it is speeded up, it uses much more fuel than at normal speed, which is around 1400 revolutions per minute. An extra tank of water will be carried in the back part of the fuselage of the plane for use in emergency, such as landing at sea, and this water may also be turned into the engine cooling system if necessary.

The four pilots and four mechanics chosen for this flight are men of unusual ability, and they will be given the first trial of skill early in the flight, for the journey will cross the Pacific Ocean soon after the start. The starting point will be Seattle, Washington, and from there it will lead up the coast of British Columbia to Prince Rupert, 650 miles from Seattle. The planes will be refueled here and continue to Sitka, Alaska, 300 miles further north. From Sitka the route will lead to Cordova, Seward, Chignik, Akutan, and Dutch Harbor. The latter place is 2360 miles from Seattle and supplies of spare parts as well as fuel have been deposited there for use if necessary. From here the flight will follow the Aleutian Islands to Attu, which is the furthermost island out in the north Pacific. A landing will be made at Attu, and a full capacity of fuel taken on, for the next stop will be Shimushu Island of the Kurile group belonging to Japan, 860 miles to the southwest. The flight could reach the Island of Mednyi off the coast of Kamchatka only 500 miles distant, but it is thought the plane can go on further south without much greater effort. The Island of Shimushu lies just off the southern tip of the Kamchatka peninsula and the aviators, after leaving Attu, will be able to reach the mainland of Asia, or this peninsula, after about six hours of flying; then the coast can be followed down to the Kurile straits which can be crossed easily and the island picked up. The flight will continue through the Japanese islands down past Yokohama, Tokyo, Nagasaki and Chemulpo. Next the coast of China will be touched and the aviators will proceed down the coast touching at Hongkong, then push on to Haiphong in French Indo-China. From here the flight will go to Siam and a landing made at Bangkok, the capital. Burma will next be entered and landings made at Rangoon and Akyab. From Akyab, the route lies over Chittagong on the way to Calcutta, India.



The round-the-world plane carrying pontoons for water landing, in flight near Hampton Roads, Va.



Cockpit of the Douglass plane, showing the instruments that keep the aviator's finger on the pulse of the Liberty motor

It will be remembered that Malins and Macmillan, the two members of the Blake expedition, went down in their seaplane with a dead motor in the Bay of Bengal between Chittagong and Akyab. They wallowed among the high seas and torrential rains until the water-soaked plane finally overturned and floated with the pontoons just a little above the water. The natives who occasionally passed them at some distance in boats gave them a wide berth, thinking they were the water devils of local tradition. The diary written by the pilot, Macmillan, of this disaster is one of the strangest and most absorbing records ever written. When we read of the despair that overcame them as ship after ship passed by without notice; of how they fired their last round from the Very's signal pistol; of how the music known as the death song of the sirens, which shipwrecked sailors hear in the last hours of thirst and fatigue, assailed the ears of the two aviators—then we feel that the world must admire those men who attempt such daring feats in the cause of science. The American aviators, however, hope to cross the Bay of Bengal without such bad luck as their English brothers had, and when they arrive at Calcutta several days will be spent in resting and probably overcoming their "sea legs."

At Calcutta, the pontoons will be removed from the airplanes and wheels put on; for the remainder of the flight to Hull, England, will be chiefly over land. From Calcutta the flight will go to Allahabad, 475 miles northwest, in the interior of India; and from there to Delhi, the capital of India. While at Delhi, courtesies will be exchanged between the American officers and the English authorities. The flyers will not tarry long in India as an effort will be made to get through to the Persian coast before the heavy rains begin. It was due to these rains, which rotted the rubber connections on the engine that Blake flew, that his expedition finally ended as it did. Little pieces of rubber kept getting into the gas line and causing trouble. If the Americans beat the rains, a great hazard will have been overcome.

From Delhi to Multan, the next stop of the flyers, 425 miles will be traversed. Care will be required on this particular trip as a course a little too far northward will take the planes over the forbidden city of Amritsar. This city is the headquarters of the ancient religious order of the Sikhs. Amritsar, or the "Pool of Immortality" contains the Golden Temple which has a copper dome covered with gold foil and it glitters in the sun with a brilliancy that dazzles the eyes. It should make a good landmark for the aviators and a good one to avoid, for within this Golden Temple is a copy of the Granth, or holy Sikh bible, above which no living mortal may place himself—and live. An aviator who might fly over the Temple would get pretty short shrift from the local Sikh magistrates if they should catch him. If the aviators land among these people, they will be able to identify them by their costume on which is carried five K's, standing for kes (uncut hair), kachh (short pants), kara (iron bangle), khanda (small steel dagger) and khanga (comb). The steel dagger is used to wrap and fasten their long hair, as well as for the other purposes of daggers. These Sikhs use no wine nor tobacco, so it will be quite

useless for the American aviators to expect to obtain cigarettes from them.

If the flyers get through this land of the Sikhs safely, they will land at Multan and "gas up," then proceed down the Indus River, skirting the great desert of Thar, to Karachi, on the Arabian Sea. From Karachi the flight will go to the little principality of Oman in southeastern Persia and a landing will be made at Charbor, the capital. The mountains rise to a height of 10,000 feet in Oman and if the aviators enter the country from the north they will probably be required to fly through a great gorge known as the Wadi Thaika, or "Devil's Gap." From here the Arabian seacoast will be followed up to the strait of Ormuz, where a landing will be effected at Bunder Abbas. From Bunder Abbas the Persian Gulf coast will be followed to Bushire, near the head of the Gulf. From Bushire the flight will go to the head of the Gulf and pick up the Shat el Arab River which is formed by the junction of the Tigris and Euphrates Rivers a short distance from the sea. This stream will be followed up to the fork of the two rivers named, when the right hand, or Tigris stream will be taken and followed up to Bagdad in Mesopotamia. Leaving Bagdad, the flyers will turn slightly westward and find the Euphrates River about 35 miles away, staying within sight of it and the western side until Lake Sabakha in northern Syria shows up as a landmark. From this point the aviators will turn due west and locate a railroad along which they will fly toward the north until Aleppo is reached. From Aleppo the flight will go to Konieh which is in Asia Minor about 150 miles north of the Mediterranean Sea, and from there the route lies to San Stefano, near the outskirts of Constantinople. From Constantinople the following places will be touched in turn: Bucharest, Belgrade, Vienna, Strassburg, Paris and Hull or perhaps London. In England the wheeled landing-gear will again be replaced by pontoons and the flight will proceed up along the coast of Scotland and on to Kirkwall in the Orkney Islands. From the Orkneys a flight of 275 miles will be made across the ocean to Thorshavn in the Faroe Islands. From the Faroes the compasses on the airplanes will be set so as to reach Iceland, 550 miles across the extreme North Atlantic. The landing will be made in Iceland at Reykjavik, the capital city.

It should be stated here that the earth-inductor compass will be carried on this flight, and it is well that a compass better than the old type of magnetic needle can be used in these latitudes, for the magnetic disturbances due to the aurora borealis throw the ordinary compass far off. But even the earth-inductor compass, which is free from local disturbances and magnetic "memory," may be affected by strange shifts of the earth's magnetic field, which some scientists believe take place in the arctic regions, especially during sun spot periods. Every precaution will be taken, however, to prevent loss of direction in flight. A radio compass direction finder is being tried out and may be used. Observations will be taken from the planes in the air. On the flight from Portugal to Brazil, Admiral Gago Coutinho, of the Portuguese Navy, found that he could take celestial observations, using the horizon of the sea for his base, and the error is not over one minute of an arc and this is almost as accurate as observations taken on board ships at sea. Also Sir Arthur Brown, the English aviator who with Sir John Alcock made the first non-stop flight across the Atlantic Ocean, took an observation at 12:25 o'clock at night, using a sextant to fix his position after sighting the Pole Star through a drift in the clouds, and using the clouds as a horizon.

The American aviators will not have much need for fear of missing the next landing place after leaving Iceland, for the east coast of Greenland can scarcely be missed if a westward course is held. There may be some difficulty, however, in hitting the exact point where the temporary base has been established. This base has been arranged for by an advance officer who has recently returned from there, and is located at the little town of Angmagsalik. This town is the only settlement on the east coast of Greenland and is northwest of Iceland, so the course the flyers will take from the latter place will bear to the northward in order not to miss the town. Angmagsalik has 200 Eskimos and 6 Europeans in it and on such a vast coast line as Greenland it may not be the easiest place to locate, especially since the coast is deeply indented with fjords, some of which extend over a hundred miles inland. The east coast of Greenland is 1650 miles long and this lone settlement must be found by the aviators for supplies before proceeding to the next fuel base at Avigtut, which is around Cape Farewell and on the west coast of Greenland. Angmagsalik has a famous landmark near it, however, in the form of the great mountain peak of Ingolfs Field which stands six thousand feet high and can be seen for many miles at sea. The distance between Iceland and Angmagsalik is 500 miles and it is very possible that this mountain will be seen by the aviators after the first three hours at sea, provided they maintain a fairly high altitude. This mountain peak is undoubtedly the Blagsark, or "Blue Shirt," spoken of in the Norse legends which was used as a landmark by the early Vikings who settled Greenland in the ninth century.

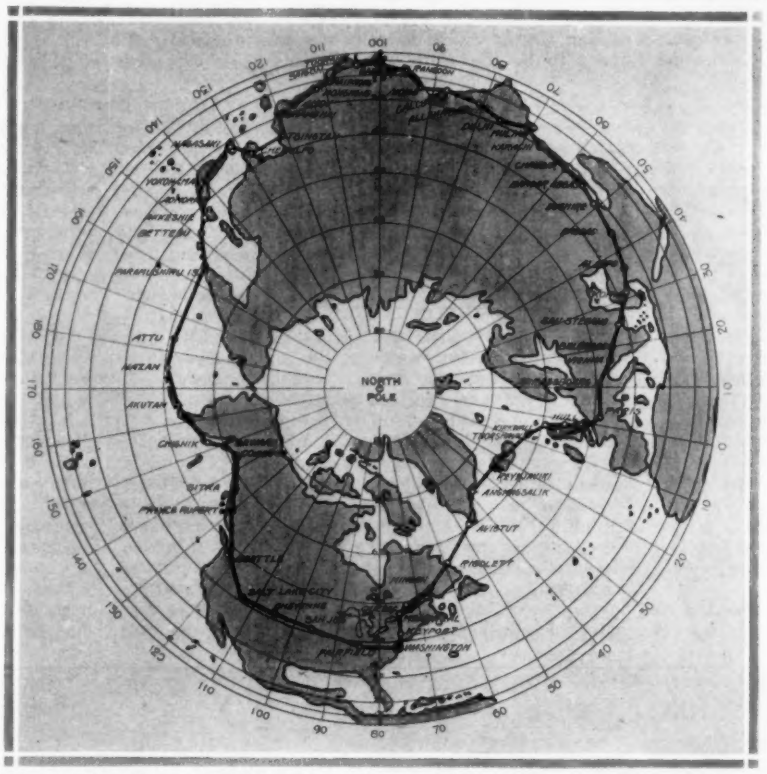
Avigtut, on the west coast, is a fair sized town for that country and a steamer for an ore company in the United States makes two trips a year to it. Arrangements have already been made for the aviators when they reach there on the homeward stretch. Ice-free land can be found as far as 80 miles inland on this west coast of Greenland near Avigtut. The Gulf Stream passes up along the coast near this town and warms the country fairly well. The winters are no colder here than in Sweden or Norway, and rarely does the temperature drop below that of a cold winter day in North Dakota or Montana in the United States.

The next leg of the world flight will be rather long. From Avigtut the route lies toward Labrador where a landing will be made at Indian Harbor, 700 miles away. Very little time will be spent here as Labrador is much colder and the weather more uncertain than that of south Greenland. The next flight will extend southward to Mingan, Quebec; thence to Quebec, Quebec; thence to Montreal and then to Keyport, New Jersey. At Keyport the pontoons will be removed from the airplanes and wheel landing gears again put on. Then the flyers will come to Washington, D. C., and after a short rest, proceed to Seattle, the place where the flight started.

There are no scientific reasons why the flight cannot be made with little difficulty. No leg of the journey will exceed 800 miles and this is easily within the fuel capacity of the plane's cruising distance. If all those little parts of motors and airplanes will hold together as they should and as the engineers expect them to do, the flight will indeed be a triumph of science in the onward struggle of mankind and the way will have been opened for the establishment of great inter-continental air routes which are sure to come. The idea of inter-continental air travel is the underlying cause for the making of this long journey. In an official announcement of the World Flight the War Department stated the purpose of the flight in these few but sufficient words:

"To demonstrate the feasibility with which aerial communication may be established between the various continents and to obtain desired information concerning the operation of present type aircraft in various climates of the world."

Juneau, Alaska, which the round-the-world winged voyagers will pass early in April if they start on schedule



The 29,000-mile route laid down for the round-the-world flyers. A few changes have been made since this map was adopted, notably the substitution of the island of Shimushu as the first landing place in Japan

Vast glaciers like this will mark the scenery as the aviators fly over the cold and bleak Arctic regions

Teapot Dome

Some Physical Facts in the Naval Oil Reserve Problem

IT WAS inevitable that when the advantages of oil as a fuel for merchant ships had been established, its use in naval ships would follow. For, in addition to the gain in economy, there would be certain strategical advantages, due to the ease with which it could be stored, and the greater speed with which a fleet could be refueled.

When it was decided to change the ships of our Navy from coal to oil-burning, and to design all future ships for the use of oil, the question at once arose as to future oil supplies. It was realized that these must be absolutely assured. Furthermore, not only must there be sufficient oil, but it must be stored in large quantities at certain bases, so located around our coasts and at outlying possessions, that the fleet, wherever it might be operating, would be within easy steaming distance of the supply stations.

In view of the feverish activity with which the oil interests were taking the oil out of the ground, it was realized that unless some provision were made for the future, the Navy might conceivably be confronted with an oil shortage, or might have to pay a price for its oil that would be a heavy drain upon the annual appropriations made by Congress for running the Navy.

Hence, it came about that the Government set apart certain rich oil lands, known officially as Naval Reserves 1, 2, and 3, which were withdrawn from public entry and reserved strictly as future sources from which the oil could be drawn as it was needed.

Naval Reserves No. 1 and No. 2, which adjoin each other, are located in California, about 55 miles to the east of San Luis Obispo. No. 1 contains 38,069 acres and No. 2 has 29,541 acres, or a combined total of 67,610 acres. These properties are of far greater value than Reserve No. 3 (Teapot Dome) which covers 9481 acres.

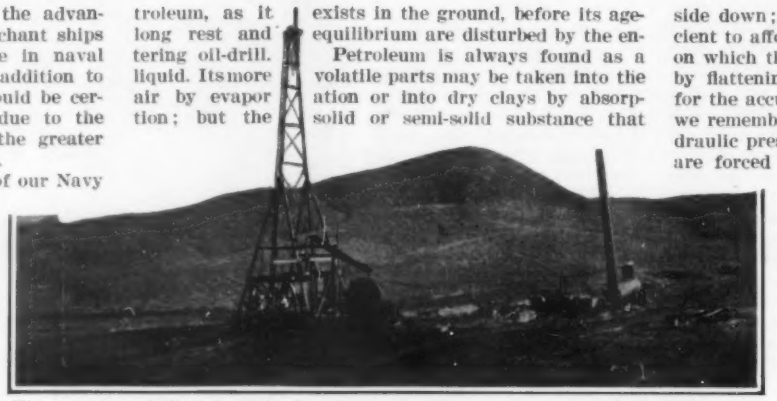
Reserve No. 1 was withdrawn from mineral entry September 27, 1909. It was set aside as a Naval Reserve September 2, 1912. On April 25, 1922 a small part of it was leased to Doheny, and on December 11, 1922, all of the public lands in this reserve were leased to the same man.

Reserve No. 2 was first withdrawn from public entry on September 27, 1909; it was set aside as a Naval Reserve on December 13, 1912.

Reserve No. 3, the now famous "Teapot Dome" reserve, like the other two is known to be very rich in oil. It is situated about 30 miles north of the town of Casper, Wyoming. The Reserve was first withdrawn in part from mineral entry on September 27, 1909. On June 18th of the following year there was another partial withdrawal. It was set aside for the Navy on April 30, 1915, and was finally leased to the Mammoth Oil Co. on April 7, 1922.

By the courtesy of Mr. G. O. Smith, Director of the Geological Survey (Department of the Interior) we present two plats showing the location and boundaries of these reserves, and a vertical section through Teapot Dome. These were prepared for the SCIENTIFIC AMERICAN by Mr. K. C. Heald, Geologist of the Geological Survey. The last-named authority has also had prepared for us the accompanying hypothetical cross section, for the purpose of illustrating the *comparative* effectiveness of wells, variously located on an anticlinal oil pool, where the oil and gas are under heavy hydraulic pressure—conditions which broadly represent those to be found in the Salt Creek and adjacent Teapot Dome fields.

Before going any further into the meaning of these cross-sections, let us consider a few facts about petroleum, as it exists in the ground, before its age-long rest and equilibrium are disturbed by the entering oil-drill.



First gusher drilled in Salt Creek Field. It was this well which led to the development of Salt Creek, which in many respects is considered by the U. S. Geological Survey to be the world's most remarkable oil pool. It adjoins Teapot Dome

Petroleum is always found as a liquid. Its volatile parts may be taken into the air by evaporation; but the more solid or semi-solid substance that remains is known as bitumen. In color the oil is generally some shade of brown. It may also be yellow or green, and even, in exceptional cases, coal-black. Roughly speaking, the color indicates its value; oil of the highest color being the most desirable. Another characteristic is its viscosity or "stickiness." Some petroleums flow as freely as water, others look and flow something like molasses. A third differing characteristic is its weight. Ordinarily, it will float on water; but a few rare oils will settle sluggishly to the bottom of a water-filled vessel. Its weight, compared with an equal volume of clear water at the same temperature, is known as its specific gravity, and the lighter the oil the higher its value; for the light oils contain a higher percentage of gasoline than the heavy ones.

Petroleum is contained in the rocks that underlie certain parts of the country, and generally it is found in beds of sand, sandstone or limestone. Associated with these beds are invariably shale and clay; and we are told by Mr. K. C. Heald, in a statement from which these notes on petroleum are gathered, that a region without shale and clay has small prospect of containing commercially valuable accumulations of petroleum. Now, in every oil field a little oil is scattered so generally through the oil-bearing beds that a well reaching these beds at almost any place is likely to get a faint showing.

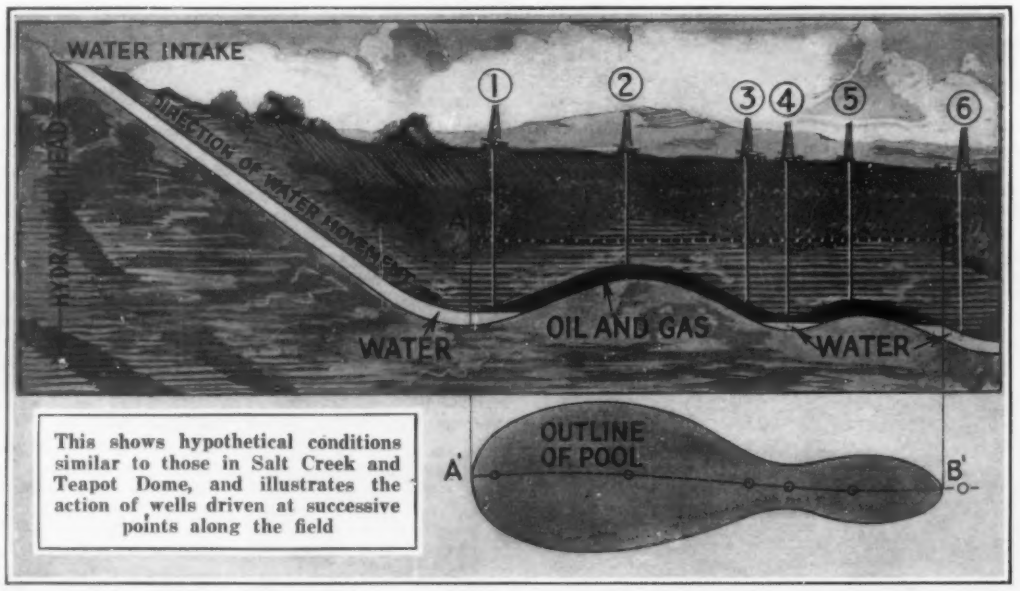
Oil in paying quantity is found only in small "pools." In these pools practically every tiny opening in the oil-bearing bed is filled with oil or with the gas that generally accompanies it. Where the oil-bearing beds are arched or bowed upward, the oil has, in many places, formed pools at the tops of the arches. The ideal form for an oil-bearing bed or set of beds is dome-shaped, like a basin or a set of basins turned upside down; but in many places simple arching is sufficient to afford a gathering ground for oil. A "terrace," on which the dip or inclination of a bed is interrupted by flattening out into a step, is moderately favorable for the accumulation of oil. This will be understood if we remember that the oil bearing strata are under hydraulic pressure, and that the oil and gas being lighter are forced upward and held by this pressure within these domes or against these terraces.

The depth at which oil may be found is limited, apparently, only by the depth to which drilling can be carried. In some fields productive oil wells have been found at a depth of only 100 feet. In other fields most of the wells are over 3000 feet deep, and some go down to more than 4000 feet. Petroleum may perhaps be obtained from depths of 5000 feet or more, but the cost of drilling would not today be justified by the probable returns on the investment.

Most of the wells drilled within the limits of an oil pool yield enough oil to make them paying investments. The pools vary greatly both in size and in yield. Some cover only an acre or two of land, others may be as large as five miles wide and twenty-five miles long, although such pools will include barren or dry spots. The average pool is about 2½ miles long, by 1¼ miles wide. A pool production of less than 4000 or 5000 barrels of oil could scarcely be dignified with the name of pool. On the other hand, the output of a large pool is measured in millions of barrels. For a period in 1916, the Cushing field of Oklahoma yielded more than 2,000,000 barrels a month. The largest well in the United States produces less than 100,000 barrels a day; but some single wells in other countries have yielded between 150,000 and 250,000 barrels a day.

Now let us turn our attention to the cross-sectional drawing showing hypothetical conditions which conform in general to those in the Salt Creek and the adjacent Teapot Dome fields. Here we have two domes with a depression between; the smaller one corresponding to the Naval Reserves. Six wells are shown along the axis of the two fields, reaching in every case the oil-bearing stratum.

Well No. 1 would yield oil for a short time, drawing part of it from the left flank of the large dome and part from the narrow band of oil to the left of the well. Water would replace any oil taken out; so that after a short time the well would produce only water.



This shows hypothetical conditions similar to those in Salt Creek and Teapot Dome, and illustrates the action of wells driven at successive points along the field

Well No. 2 is in a particularly effective position. It would drain oil from the top and sides of the dome, and the encroachment of water on the flanks of the domes, following the extraction of the oil, would not affect this oil until a long time had elapsed.

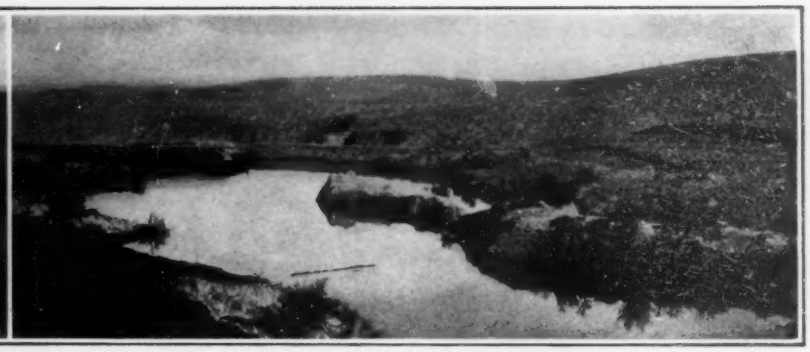
Well No. 3 would be moderately effective in draining oil from the pool, drawing most of it from the right flank of the large dome but a little from the sag or saddle between the two domes. However, as oil was withdrawn from the pool, and particularly through well No. 4, water could come in from the sides of the domes and fill the sag or saddle, forcing well No. 3 to drain all its oil from the large dome.

Well No. 4 is poorly located for large and lasting production, for the withdrawal of a comparatively small amount of oil will permit the water that surrounds the dome to creep into the saddle and fill the sand surrounding the well; so that the well will yield not oil but water.

Well No. 5, like well No. 2, is excellently located to yield oil for a long time.

Well No. 6 will obtain no oil, even though suction is placed on it and great volumes of fluid produced; for

Early wells at north end of Salt Creek anticline



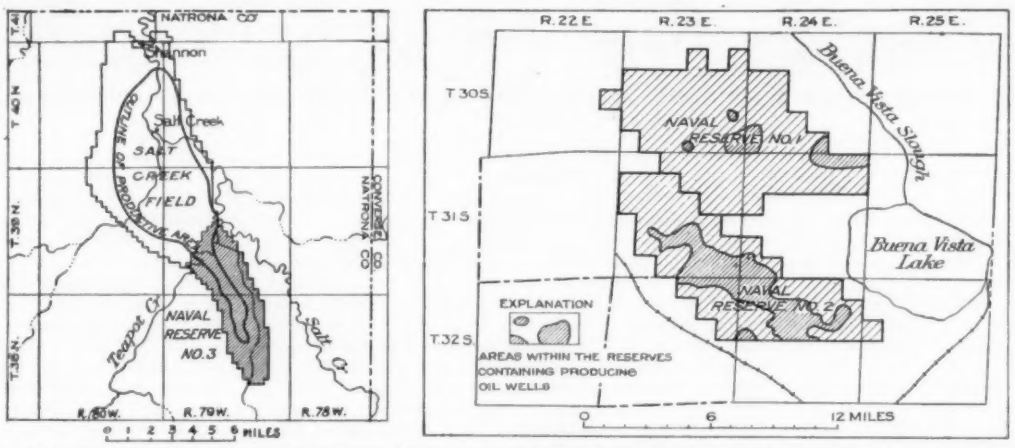
Pool of oil from the first Salt Creek gusher

water moves more readily through sand than does oil, and the supply of water is inexhaustible.

Now consider the drawing showing an actual cross-section through Teapot Dome and Salt Creek. It is taken from a map by Fisher & Lawrie prepared for the Midwest Refining Company. The cross-section runs approximately north and south. The attitude of the top surface of the First Wall Creek sand is determined from the map, and the relation of the Second Wall Creek sand and the approximate dips of the faults are taken from the testimony of F. C. Clapp (Geological report) of the Senate Committee on Public Lands.

Now this cross-section answers the question (a very important question in its bearing upon the present controversy) as to whether Teapot Dome was threatened by wells which were being drilled in the Salt Creek property; for it will be noticed that Naval Reserve No. 3 includes not only all of Teapot Dome but also the south end of the Salt Creek anticline or arch. Hence, wells driven north of the Naval Reserve boundary would drain oil from the Salt Creek anticline and not from the Teapot Dome.

Let us now consider the disposal which the Navy has made of its oil reserves. It has been pretty well established that there was a division of opinion among the Naval authorities as to whether the Naval Reserve oil was being drained away by wells sunk on the property adjoining these reserves. Mr. Denby, the Secretary, and Chief-Engineer Rear-Admiral Robison, believed that these oil fields were so endangered. So, as the public already knows, the fields were transferred back to the Interior Department and contracts were made with certain private interests, who agreed to take out the oil at a royalty; refine it; build extensive tankage facilities at certain specified Naval bases; and store the fuel oil therein, in the possession of the Navy and ready for Naval use.



Left: Plat of Teapot Dome, which is shown shaded; with Salt Creek Field adjoining. *Right:* Plat of Naval Reserves No. 1 and No. 2; open shading shows the reserved territory, close shading the areas of producing wells

The geography of the naval oil problem

tilities calling for large available fuel-oil supplies.

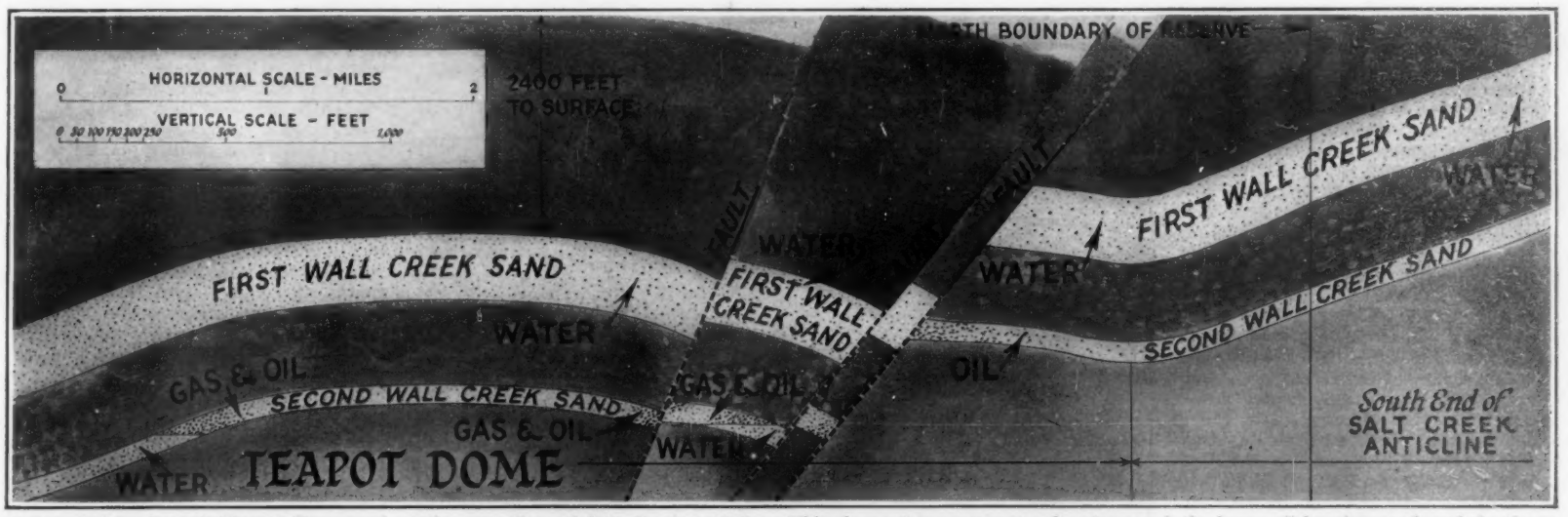
In this connection it should be noted that the British Admiralty, who are credited with farsighted vision in Naval affairs, have expended $35,000,000 since the war in the construction of tanks at fueling stations and the purchase of oil, and they are spending about $5,000,000 yearly for Naval oil and the extension of fueling facilities. The policy of our Navy, decided upon in 1919, contemplated the erection of supply tanks at Pearl Harbor in the Hawaiian Islands; at Manila, Philippine Islands; and at selected bases both on the Atlantic and Pacific Coasts. This would have provided the Navy with one year's supply. At Pearl Harbor there would have been 2,700,000 barrels; and this contract is about 60 per cent completed. One million barrels were to be placed in tanks in Southern California, and 3,000,000 barrels along the Atlantic Coast.

How Earthworms Learn

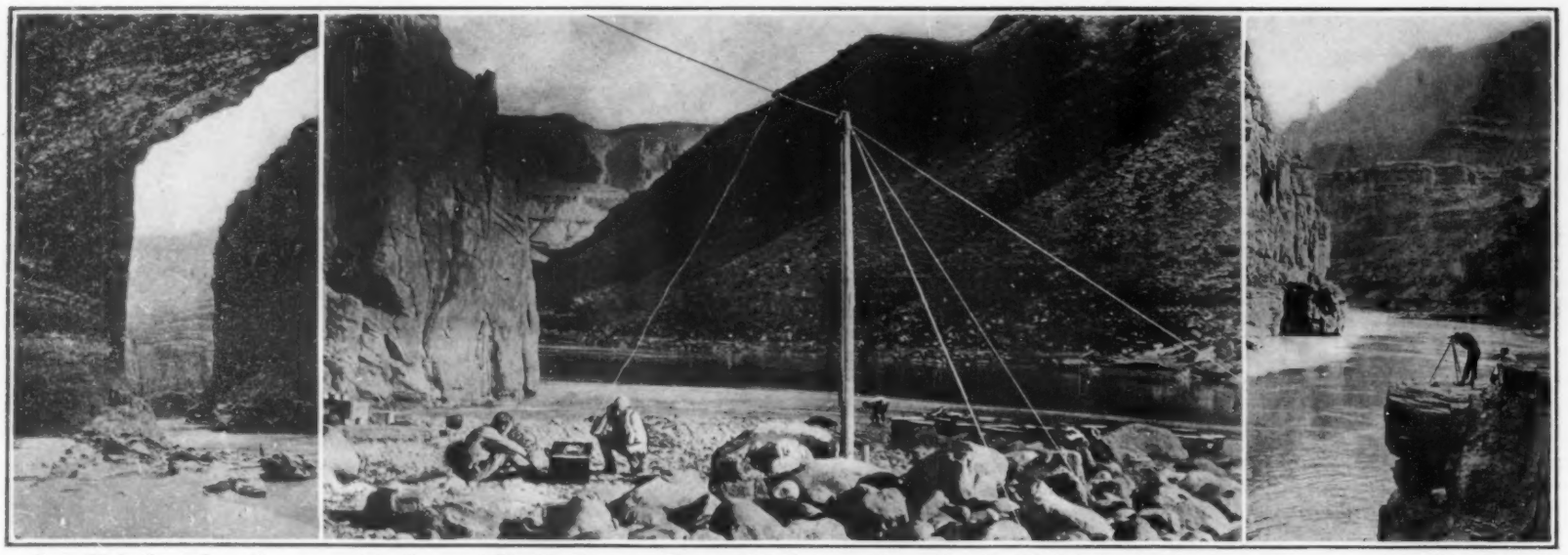
EARTHWORMS have memory and may be trained, it has been shown by Prof. Heck of the University of Prague as the result of experiments with a collection of worms some five hundred in number. The worms were introduced into a passage shaped like a capital T and carved from a block of wood which was covered with a glass plate so that the movements of the little creatures might be observed. When they came to the junction about half of them turned one way and half the other.

Then the apparatus was so arranged that those worms that took the left-hand passage received a mild but presumably disagreeable electric shock. At first the worms did not know just what to make of all this, but after they had all been through the experience about two hundred times, they nearly all took the right-hand turn. When the electrodes were then moved to the right-hand passage the worms learned to shift to the other passage after only 65 trials, evidently showing something more than the mere operation of chance.

In the human sense, earthworms have no brains; their nervous systems consist of a series of little ganglions, or nerve centers, on the under side of the worms and connected with each other by nerve fibers. If the worms were cut in two, the fragments still showed the ability to distinguish between the safe and the unpleasant road to travel, indicating that the earthworm remembers in every one of its ganglions, and that it is able to learn and profit by experience.



Cross section through Teapot Dome and southern portion of Salt Creek anticline. This shows the upper, water-bearing sand, the lower oil-bearing sand, and the three faults that have occurred. Note that wells driven north of the Naval Reserve boundary would drain oil from the Salt Creek anticline but not from Teapot Dome



Left: View through a side canyon into the great Marble Canyon. *Center:* Col. Birdseye hears that the Washington ball team won a game—via radio. *Right:* Engineers at work in Marble Canyon

Running the Rapids of the Grand Canyon

An Exceptionally Hazardous Piece of Surveying and Mapping by Uncle Sam's Topographers

By Guy E. Mitchell
U. S. Geological Survey

THE great project of accurately surveying and mapping the Colorado River from its source to its mouth has been completed by topographic engineers of the U. S. Geological Survey. Combined with this has been a geologic examination of the rock structure of the canyon so that, for a distance of 1400 miles during which the river falls some 14,000 feet, Uncle Sam now has exact data of river gradient, depths of the main canyon and the side canyons, and the character of rock formations, with special reference to the feasibility of dam sites for the control of our second greatest river which has cut out the most stupendous gorge in the world.

The most difficult and dangerous portion of the project, some 300 miles, including all of the Grand Canyon, was left to the last; and this has recently been completed under the leadership of Colonel Claude H. Birdseye, Chief Topographic Engineer of the Geological Survey. Entire success attended this hazardous undertaking, due largely to the care taken in picking experienced, well seasoned, men to whom hardship and adventure are simply part of the day's work. The party consisted, besides Colonel Birdseye, of E. C. LaRue, hydraulic engineer, who has for years made a great study of the Colorado River, R. W. Burchard, topographic engineer who had already surveyed the lower stretches of the river, Herman Stabler, hydraulic engineer who made a partial descent of the river last year, all of the Geological Survey; R. C. Moore, State Geologist of Kansas, who for two years has been making geological investigations in Utah and Arizona; Emery C. Kolb, who in 1911, with his brother, made a boat trip through the Grand Canyon to the Gulf of California; Lewis R. Freeman, of Pasadena, California, a well-known explorer, writer, and boatman; Leigh Lynt, of Weiser, Idaho, and H. E. Blake, Jr., of Monticello, Utah, two husky youngsters, with two years experience in boating the rapids of the Colorado; Frank B. Dodge, of Honolulu, as skillful a boatman and expert a swimmer as any native Hawaiian; and a cook.

The trip was made in four small heavy wooden boats, which carried all the supplies and instruments of the party, and also, except at the portages, the men themselves. The party had also a special radio receiving set and complete photographical equipment. While this was not the first trip down the Canyon, Major J. W. Powell in 1879 having disproved the Indian stories of giant waterfalls and underground channels, impassable whirlpools and like terrors, the trip was filled with adventures and dangers, a single day's experience of which would have remained forever in the memory of any "tenderfoot" who might have been along. During the period of preparation for the trip many applications from adventurous spirits desiring to accompany the party, were firmly refused. Only proven and capable men equal to any emergency were wanted, for the great adventure was a simple business undertaking to carry through an accurate survey of the Canyon, to locate sites at which dams for irrigation and power development might be built to utilize the vast volume of waste waters of the Colorado, and to insure flood prevention. Colonel Birdseye kept daily notes of the voyage and since his return he has given several lectures describing the trip. Both his diary and his talk seem somewhat commonplace accounts of an unusually rough river trip; but it is easy enough to construct between the lines an adventure which, if undertaken by less experienced explorers and resourceful men would have ended in disaster and failure a dozen times. Day after day the tide of the great river swept the men into just one danger after another—rapids, whirlpools, frightful swirls, rapids and rapids again, racing their boats between almost sheer or overhanging walls thousands of feet high.

The party started down stream from Lees Ferry, Arizona, on August 1, and for 3½ months, without stay or rest, they battled among the waters for a total distance of nearly 400 miles. A few examples of the "high spots" of the trip may give a slight idea of the things encountered. On August 3 for instance the party portaged the boats past Soap Creek rapids. These rapids have never been safely run by any party, and here the Kolbs in 1911 upset both their boats. "It was man-killing work" says Colonel Birdseye, "to portage these heavy 900-pound boats across immense rocks, and perhaps we might have come through safely without portaging, for we later ran worse rapids, but it did not seem wise to take the chance so early in the trip. The next day we reached a wicked looking rapid, running between vertical cliffs directly from the boiling water, with no foothold for a portage and no chance even to look the rapids over and form a plan for running them. We called them 'Sheer Wall Rapids' but we ran them safely, although soaked to the skin. Such rapids we always ran with the boats stern first. We slipped on cork life jackets with Kapok collars, and except the boatman, lay face down in the cockpit of the boats, clinging hard to the life lines stretched across the decks. The waves seemed mountainous and to some of us our first ride of this kind was a genuine thriller; but we afterwards became so used to riding rough water that we vied with one another to make the plunge with a lighted pipe or cigarette and not lose the light."

In running Boulder Rapids, one of the boatmen, Blake, was thrown out of his boat by the tremendous force of the waves and turned a complete somersault, going out of sight beneath the muddy swirl; but he bobbed up like a cork, outswam his boat and climbing in, fought on through the rapids.

The dreaded Sockdologer Rapids was reached the latter part of August. The fall is 19 feet, mostly in the first hundred yards, and the waves measured a full 20 feet from trough to crest—something of a wave in a river running faster than any mill race. The next morning the boats plunged into Grapevine Rapids, described as a regular terror, which, besides running like the tail races of Hades, has more than its share of big jagged rocks. Near Spectre Chasm the boats shot into a small rapid where, according to Colonel Birdseye, the party was in greater danger than at any other point on the trip. The channel here is shaped like a letter S and the lashing current drove the boats upon a large mass of wicked rock that lies midway of the rapids. Two of the boats missed this rock very narrowly and one struck it lightly. Burchard pushed against the rock with his hands and kept the boat off, and Lynt said he had scraped the flies off of one side of his boat and hoped that they would not annoy him further.

In a dangerous rapid below Kanab Creek, Kolb ran first and was drawn into a great swirl, where his boat turned upside down and he disappeared. Dodge courageously plunged into the torrent and caught the boat at the foot of the rapids. It looked as if Kolb were gone but he

The boat "Marble" of the Geological Survey Grand Canyon expedition beached for repairs

popped out from under the cockpit of his boat almost unharmed, though he coughed up some water. It was all over in a minute and forgotten, with only a couple of passing yells and grins of congratulation.

At the mouth of Tapeats Creek, on September 8, the radio was set up for the first time in a week and KHJ at Los Angeles came in clear. The walls of the Canyon are here not far short of a mile high, but the party heard that a great earthquake had occurred in Japan and that the Washington Baseball Club had won a game—despite the prediction of radio experts that it would be impossible to hear anything in such a deep canyon. At Fishtail Canyon, on September 10, the party photographed the eclipse of the sun which was there 75 per cent of a total eclipse.

Amid the excitement of running rapids and the men's dare-devil defiance of the swirling waters of the Canyon, the scientific members of the party worked methodically on the main purpose of the expedition. At numerous points the surveying instruments were set up, photographs were taken, and calculations were made in furtherance of the larger ends in view.

One of the unexpected incidents of the trip was a big and unseasonable flood. Camp had been made September 18, on a small sandbar below the famous Lava Falls, when the river soon began to rise. By 8 o'clock the boats were pounding badly and it became necessary to find a safer place for them. Two of the men therefore pushed off downstream in one of the boats with lantern and flashlight, and in about an hour returned overland to report that they had found a shelving limestone shore up which the boats might be dragged. No one expected a rise of more than 5 or 6 feet but the boats were nevertheless run down, and as it turned out it was a sleepless night for the men, for the water rosé rapidly, and they were kept busy dragging one boat after another out of the water to higher places. The cook went to bed 10 feet above water but was flooded out at midnight. Colonel Birdseye lay down at 2:30 in the morning on a rocky slab 20 feet above low water but two hours later was awakened by waves lashing the rock. By morning the river had risen 16 feet, a sullen, surging flood, and it continued to rise all day, reaching a peak of 21 feet. Measured in volume the excess flow was estimated at 100,000 cubic feet of water running by each second. This flood gave rise to sensational newspaper reports that the party had been lost.

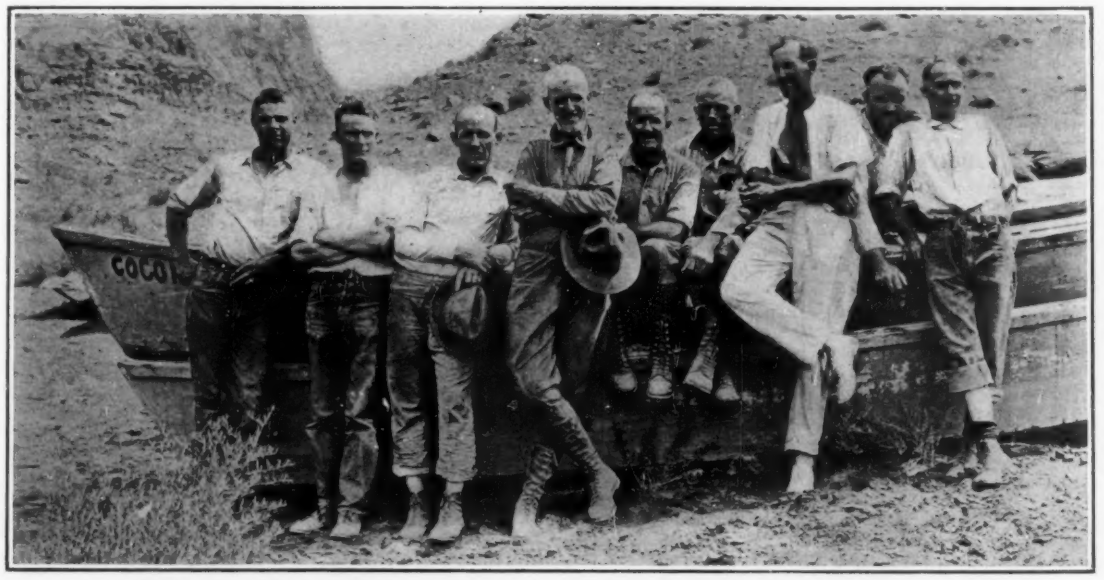
Lava Falls at the height of the flood. The water reached a peak of 21 feet. It was estimated that 100,000 cubic feet of water ran by each second

One of the incidents of the trip was when Burchard, the topographic engineer, fell on the rocks and broke a rib, but insisted on continuing his survey with his side bound up with surgeon's plaster. With the exception of the first day's work, below Lees Ferry, he had made the entire survey of the river, and he wanted to carry the line down to connect with his old work just above the mouth of the Grand Canyon. He is responsible for the entire survey through Marble, Grand, Boulder, and Black canyons, a distance of over 400 miles. In spite of the rib, he was successful in his effort, and was able to finish the work which he had started several years before.

From the juncture of Diamond Creek Canyon with the main gorge the boats plunged through rapid after rapid. One of the worst was Separation Rapids, the place where three members of Major Powell's first expedition left the canyon in discouragement and apprehension, and were soon afterward killed by the Indians, Powell and the others of his party going through safely.

The rapids here have a short fall of nearly 20 feet, and they looked wicked and dangerous. The sheer walls left no chance to pass around them, so everyone had a free ride on the boats. Kolb, Blake, and Lynt ran their boats safely but the deck loads made the boats top-heavy and caused them to dance about in the torrent like corks even after the cockpits were filled with water, giving the passengers the roughest ride they had had since the Sockdologer. Freeman ran last, with LaRue and Moore clinging to the hatches. These three surely must have had one of the thrills of their lives, for the huge twenty-foot waves tossed the boat in the air, and when it came down, bottom side up, they were thrown out between the boat and the rocks on the bank. LaRue in particular narrowly escaped being crushed to death or badly cut as the torrential water rolled him about between the sharp rocks and the heavy boat.

Freeman had dived clear of the boat and had come up a few yards from it, where he caught a rope. Blake and Dodge pushed out in their boat to render assistance, Dodge grasped the painter and helped to haul LaRue aboard, Freeman and Moore holding hard to the upturned boat, which was towed out of the surging torrent into quieter water and righted. Moore and Freeman seemed really to enjoy this exciting experience, but nevertheless decided that one trial was sufficient. LaRue admitted without hestation that he didn't like it at all.



Col. Birdseye and his party of surveyors and engineers who made the Colorado Canyon trip

While the success of the work of the expedition is to be attributed largely to the able leadership of Colonel Birdseye, the persistence of the indefatigable Burchard and the skill and good judgment of the head boatman, Emery Kolb, in piloting the boats through the savage waters of the Canyon, it can be seen that all of it was real men's work.

Painting the Cylinder Head to Increase the Power

AN interesting invention for the improvement of automobile performance based on an entirely new principle as far as the automobile industry is concerned has now been perfected and brought on the market. While almost all inventors have tried to improve the mechanical features of an internal combustion engine, this invention touches the basic principle of the internal combustion engine, namely, the chemical process in the combustion of the fuel.

The reader will be familiar with the phenomena of catalytic action, involving the use of a catalyst, frequently a metal in a finely divided state, which accelerates the rate of a chemical reaction by its mere presence, without itself undergoing any permanent change. The most familiar applications of catalytic action are the gas mantle, the manufacture of sulfuric acid by the contact process, the hardening of oil and fats, and the manufacture of ammonia from atmospheric nitrogen. The latter process acquired international importance during the war, as it enabled Germany to offset to a large extent the lack of imports of Chili nitrates in the manufacture of explosives.

This principle has been applied by Dr. E. Sokal to the acceleration of combustion in internal combustion engines, thereby effecting a more complete, as well as a more rapid burning of the fuel, thus increasing the power and flexibility of the engine, and leading to an appreciable fuel economy due to the possibility of using leaner mixtures and the reduction of carbon deposits.

The invention is remarkable for the great simplicity of its application and working. The catalytic agent is mixed with a special binder and applied in the form of a paint to the cylinder head, where it remains unaltered for a great length of time, in fact cars that have been so prepared have run 15,000 miles and more without any appreciable lessening of the beneficial effects of the catalytic agent.

Very exact laboratory dynamometer tests, as well as extensive road tests have been made by some of the leading authorities on automobile engineering, by several large automobile manufacturers, as well as by the Bureau of Standards. In every case the result has been satisfactory. The effects of the catalytic agent differ of course with different types of engines. It has shown the most striking results with the lighter and more popular cars. In one case, the average increase in mileage obtained in eleven road tests was 30 per cent.

In the course of his investigation, the inventor has incidentally cleared up a very interesting point in automobile engineering. The question of detonation in the internal combustion engines has greatly puzzled the experts, and the generally accepted theory was by Mr. Midgley, who tried to explain the detonation by too rapid combustion. From Dr. Sokal's investigations it seems now clearly established that detonation is caused by the decomposition (cracking) of the very complex hydro-carbon molecules of the fuel. This decomposition would of course tend to increase the number of molecules, the impact of which against the piston head would then cause the phenomenon of detonation. The accelerated combustion produced by the catalytic agent naturally tends to obviate this.

A Theater Without a Stage

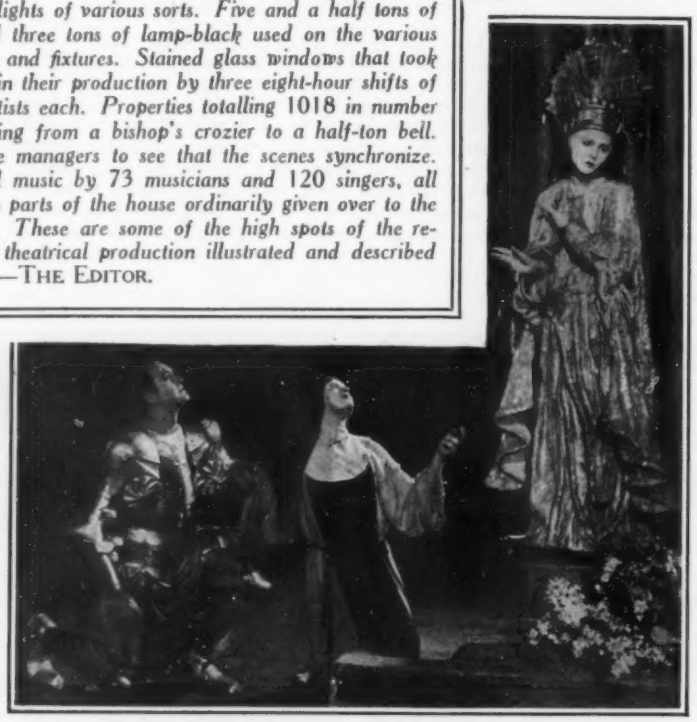
The Whole Building Given Over to the Play with the Audience Part of the Scenery

By Albert A. Hopkins

WHEN a theater becomes a conventual church; when the orchestra and choir go up in the balcony; when the curtain is thrown away; when audience and actors mix—then we certainly have an upset theater, to say the least. Yet all this happens eight times a week at the Century Theater, New York, where Max Reinhardt has staged "The Miracle" for Morris Gest.

First, let us say that the play is wordless, which eliminates to a large extent one of the most important means of expression of the actor. Then in the dim religious light much of the facial expression is necessarily lost. Therefore, it is necessary to make this up by other methods. There are certain old stories and legends like the "Ring" which appear and reappear and are never entirely dead. One of these, the story of the Virgin and the Nun, comes around in one form or another as the "Soeur Béatrice" of Maeterlinck, "A Ballad of a Nun," and others. The compelling cause of the spectacle was the fact that they needed at "Olympia" in London a performance which could be visited by thirty thousand people daily. Of course the spoken drama was impossible and "The Miracle" was the result. The author was Karl Vollmoeller, the composer was the erudite Prof. Humperdinck, the talented creator of "Hansel and Gretel," and Reinhardt made up the balance. Since 1911 this production has had a most profound influence upon the arts of the theater, especially in England where something was needed to shock the theater out of its time-honored groove. From London "The Miracle" spread all over Europe and there were seventeen producing centers besides a traveling company. In New York "The Miracle" was scheduled for Dec. 9, 1914, and everything was in work when the thunderbolt broke; so it was not until Jan. 15, 1924, that the New York premiere came off.

FOUR electric motors that raise 12 tons of scenery more than 60 feet to effect a lightning change of scene. Wings 60 feet high against 16 in the ordinary production. Three thousand individual costumes, of 470 patterns. Thousands of lights of various sorts. Five and a half tons of paint and three tons of lamp-black used on the various properties and fixtures. Stained glass windows that took 22 days in their production by three eight-hour shifts of twelve artists each. Properties totalling 1018 in number and running from a bishop's crozier to a half-ton bell. Ten stage managers to see that the scenes synchronize. Incidental music by 73 musicians and 120 singers, all located in parts of the house ordinarily given over to the audience. These are some of the high spots of the remarkable theatrical production illustrated and described herewith.—THE EDITOR.



A pantomime cannot be produced like a play on any stage, independent of its size and shape and without consideration of the size and shape of the auditorium. Space, music and acting must be thoroughly correlated, must become an indivisible unit, a living organism with its own laws and necessities. The play, the music and the acting in any pantomime are algebraically speaking, functions of the space. The slightest variation of any distance necessitates a corresponding change in the music, in the movements of the actors, in the arrangements of the producer. The Century Theater was cast in a glorious mold, the vast stage lending itself to massive scenic productions; nevertheless, in the front of the house four hundred seats had to be scrapped to allow for the orchestra and choirs in the balcony, and to bring the action well into the orchestra.

One enters the dimly lighted church, for such it has really become; and one is assisted to one's seat by ushers disguised as lay sisters. One would almost think one was in some fane in Rouen or on the Rhine; the glorious arches, tall columns and stained glass windows at sides as well as in the sanctuary help the illusion. Presently the aged sacristan comes in and the lone red sanctuary lamp is augmented by the lights on the altar. The far away bells begin to ring. It is the Angelus and the choir and the people in the production join in the grand old Latin prayer. The procession comes right up the aisles past the audience with candles, crucifix, etc., and with the clergy in proper ecclesiastical vestments. A young nun receives the veil from the Abbess and is then entrusted with the keys of the church. Her special duty is to watch a miracle-working statue of the Virgin and Child. She finally revolts at the discipline and implores the Virgin to release her from her vows and let her become once more of the children of the world; and as she commits a great sacrilege by tearing away the Child, the altar opens and she joins her lover. The statue of the Virgin then comes to life and she assumes the habit and duties of the nun. After seven years the recreant nun having passed through all phases of life as portrayed in the wonderful scenes, eight in number, comes again into the cathedral; and the materialized Virgin assumes her discarded robes and crown and once more becomes immobile. The erring nun puts on her vestments which the Virgin has left at the base of her throne and as if the bitter taste of life had been only a dream, she rings the Angelus bell and the sisters come in only to find that a miracle has been performed. In an ecstasy of religious fervor the statue is carried toward the altar and is raised on high in a gorgeous scene which ends the performance and the audience file out without applauding.

This is a very meagre description of what happens and one must see it to understand the story. We can at least, with the aid of our detailed drawing, tell how it is managed. On the stage proper is erected a horseshoe-shaped platform corresponding to the apse, or circular end of a church, and covering 6500 square feet. Twenty huge columns 60 feet high end in a vaulted ceiling. The columns and ceiling weigh over twenty-five tons and are fixed. There are eleven solid wings, as side scenes are called, each 13½ feet wide by 60 feet high. The ordinary wing measures 4½ feet wide by 16 feet high. There are six cathedral stained glass windows, measuring 10 feet by 37. Three artists, working eight hours a day for 5½ months, painted the models for these windows. Behind these huge wings are nine groups of vaulted chapel columns rising 50 feet. Thirteen ornamental iron gates are also part of the cathedral scheme. The altar, occupying the center of the stage, covers an area of 240 square feet and is 37 feet high. The entire stage setting is masked at the rear by a cyclorama of 14,000 square feet of black felt, the largest ever made, and sufficient to cover 10 city lots. The floor covering is 6700 square feet of linen duck, over which is an equal amount of asbestos slate to give the required antique floor effect of a cathedral. The proscenium opening is constructed in a series of three arches. To build this required 15,000 square feet of molding, 5000 feet of lumber, 10 barrels of plaster and 20 rolls of wire mesh. To the right of the proscenium arch is a turret, 60 feet in height, inside of which is incorporated a flight of 60 steps, which is used by only one character in the play, and that for less than five minutes.

The wings, the altar gates and the columns in the vaulted chapel are heavily counterweighted. They all rise at once and are hauled up out of sight by four electric motors on the "gridiron" 116 feet above the stage. Three motors actuate two steel shafts 75 feet long on which are secured 27 drums hauling a weight 24,300 pounds a distance of 80 feet in a short time. One can hear the "quick change" but cannot see it as the stage is in total darkness which is made perfect by a smoke screen. In the last scene the cathedral is once more restored as quickly as it was destroyed by a reversal of the operation.

The chief electrician has a most difficult job as the least bungling would produce dire confusion. He sits in the top gallery in the center with six huge spotlights to the right and left in the hands of expert operators, and watch in hand follows the minutest turn of the drama enacted a hundred feet below. With telephone he gives the quick and decisive orders which are received by the electricians at the enormous switchboards in the wings. Here with the aid of switches and dimmers the slightest orders are translated into surging or ebbing flows of light. In addition to the spotlights in the top gallery, there are in the two lower balconies 150 one-thousand-watt spotlights, which are controlled from the main switchboard. There are also on the stage 150 bunch-lights, 20 arc lights, 120 four-hundred-watt steropticon lights, 1500 lights in the fire-fly effect, also stars in the ceiling. The cast uses electric candles. The stained glass windows are all lighted up from the rear by powerful 1000-watt hanging bunch-lights visible from the promenade.

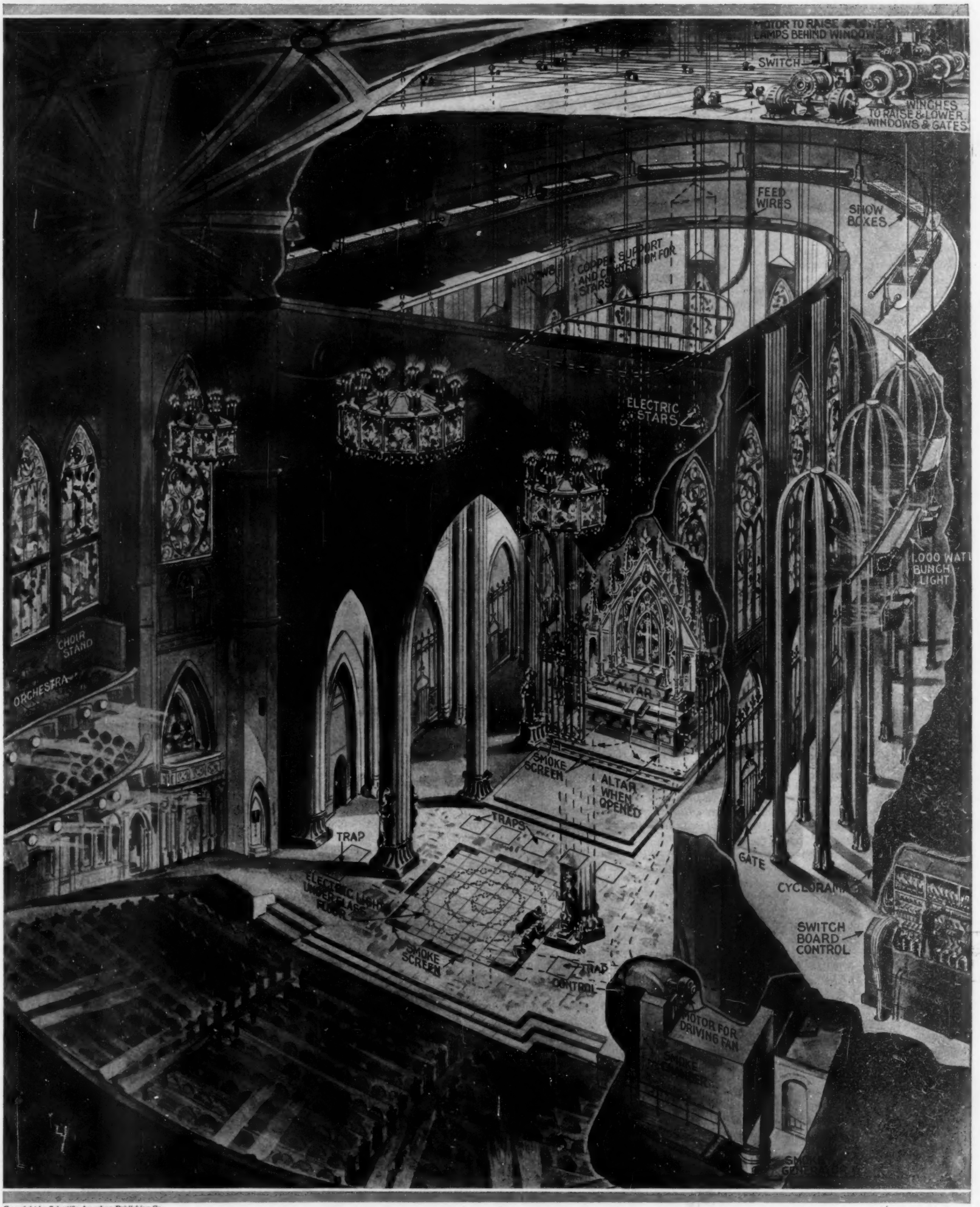
Through the kindness of Mr. Eugene Braun, we have been enabled to see everything electrical in his charge under the very best conditions, for an electrician in a great production must be a kind of daily inventor. True the effect may not always work but it may be a stepping stone to something the next day, which will. Practical men of the stage have the courage of their convictions. Two tons of stage snow were provided made of fireproof paper and were shaken down from the rim of the horseshoe at the sides of the false ceiling of the cathedral. It was found that this snow fouled the lamps and it was abandoned.

One of the most striking effects is produced by flooring with glass a portion of the front of the stage beyond the line of the absent proscenium arch; and placing, underneath in the first cellar, spotlights controlled by a regulator. Much of the allegorical action occurs here, the "shadow of death" appearing at the end of each scene, when one or more of the actors lie on the vivid flooring. The ultra-violet ray is used at the end of every scene, the apparatus being attached to four of the spotlamps in the top gallery. The unearthly and ghastly color is produced by projecting these rays on a white cap used by one of the actors.

The smoke for the screening of the "quick change" is generated in the lower cellar and is kept in a large galvanized iron tank in the intermediate cellar, to be driven by fans through sheet metal pipes to the outlets at different parts of the stage. We are indebted to Mr. Oliver M. Sayler, author of "Max Reinhardt and His Theater" for many courtesies in connection with the present article.

Patent Office Procedure

OF considerable value to all those interested in the prosecution of patent cases, whether attorneys, inventors or examiners, is a pamphlet published by the Patent Office Society under the title "Manual of Patent Office Procedure." It contains a very comprehensive summary of the sort of thing which its title covers, made by E. S. Glascock, one of the Principal Examiners in the Patent Office; together with such of the Commissioner's orders as are still alive and pertinent to present practice. Since some of these orders date back as far as 1875, and only a small proportion of them are still effective, it is obvious that on this count alone the book contains much information difficult to locate elsewhere. The same is true of the actual procedure.



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The entire stage back of the first columns is arranged so that all the scenery is raised at one time while obscured by a smoke screen. The space is so large that our artist has had to take certain liberties with the gridiron to get in all of the mechanism

HOW THE CENTURY THEATRE WAS CONVERTED INTO A CATHEDRAL FOR THE PRODUCTION OF "THE MIRACLE"

Our Point of View

The Public Conscience

ELSEWHERE in the present issue will be found a discussion of the technical aspects of the Naval oil reserves, which will throw some light upon the question as to whether it was better to leave the oil in the ground as crude petroleum, or pump it out and place it in tanks ready for emergency use.

The heading "our point of view" at the top of this page, leads us to go a little further and give expression to a feeling which, for us at least, stands out preeminently above the many emotions of shame and humiliation, which have been aroused by the Naval Reserve scandal. We have in mind the healthy reaction of the public conscience, as shown in the universal demand, that any man who shall be proved to have betrayed the public trust, no matter how exalted his social or political standing, be brought to justice, and punished with the utmost vigor of the law.

The heart of the American people is sound; and we believe that the men they elect to represent them at Washington appreciate the sacred nature of their trust. Such faults as they may have are those of the head, not of the heart. In their probity and good faith, they are representative, surely, of the public conscience. Should the time ever come, however, when the American people lose faith in the unassailable rectitude of their President and his Cabinet, their Senators and their Representatives, we may look to see a Mussolini come striding across the land, or a Cromwell pointing to some insignia in the halls of Congress and shouting "Take away that bauble!"

How far we are removed from any such debacle has been shown in the ruthless determination of President Coolidge and the Senate to cut out this moral cancer and run the knife along its roots until not a vestige remains. There is no room for politics around the operating table; and the present investigation must be carried through in the non-partisan spirit which characterized the public utterance of the President.

Propaganda

THERE is no word in the English Language whose meaning has been so sadly distorted as the word "propaganda." The change took place mainly during the late war when the term took on a decidedly sinister complexion.

If you turn to the Standard Dictionary, you will find that the word was applied to a congregation or society of cardinals for the care and oversight of foreign missions which was instituted at Rome in the year 1622. It was applied also to the College of the Propaganda at Rome that was founded by Pope Urban VIII., for the education of the missionary priests. Hence, in later years the word came to be applied to any institution or scheme for propagating a doctrine or system.

Judged by this definition, we can see that in its true sense propaganda is a perfectly legitimate form of human activity. Any society, whether it be social, religious or political, which is possessed of certain beliefs, and sets out to make them known, either by the spoken or written word, is practicing propaganda.

Truth is mighty and must prevail, and if any body of men believe that they have discovered a valuable truth, it is not merely their privilege but their duty to disseminate that truth. If they realize, as they quickly must, that this spreading of the truth can be done upon a large scale and effectively only by organized effort, they will make use of the press and the platform as the best means to give it wide circulation. Propaganda becomes vicious and reprehensive only when its authors consciously and deliberately disseminate what they know to be lies, or when they aim at effects which they know to be prejudicial to the common good.

Propaganda in its proper meaning is a perfectly wholesome word, of honest parentage, and with an honorable history. The fact that it should today be carrying a sinister meaning merely shows how much of the child remains in the average adult. A group of citizens writes and talks in favor of a certain course of action in some debatable question, believing that it is promoting the best interests of the community. Propaganda? Not a bit of it. Just a plain forceful statement of truth. But let another group of citizens express opposing views, and they are promptly labeled with the sinister name of propaganda.

A curious illustration of this illogical attitude and the misuse of a perfectly good word was seen in the Senate investigation of the Bok Peace Plan. Many of the active members of the Committee had been foremost among the opponents of the principles contained in the League of Nations. In the Senate and out of it, on the platform and in the press, they had shown an opposition to the League which became almost pathetic in its unreasoning fury. Was this propaganda? Perish the thought! But when a private citizen, wishful of getting a cross-section of public opinion on the question, offered a prize and published the winning essay, these gentlemen of the Senate felt that they had put the whole matter completely under the ban when they shouted propaganda! propaganda!

"What is sauce for the goose is sauce for the gander" says a wise old proverb. Let us make haste to put this fine old word back where it belongs, and restore its dignified significance for the use of our children and our children's children.

Save the Birds

EVERY year millions of migratory birds wing their way across the United States. During their long flights, they break their journey at suitable resting places, which in the case of waterfowl consist of certain marshes and the bordering shallows of our lakes and rivers, which the birds have used, year by year from time immemorial as places of rest and for feeding and mating. These marshes are as essential to the existence of our waterfowl as the very air they breathe.

Bird-hunting is as ancient as the history of man himself. From the very first it has formed an important source of his food supply; and through untold centuries the supply was seemingly inexhaustible. But the earth's population multiplied; weapons of precision were placed within reach of the poorest huntsman; and it began to be evident that, unless the protecting arm of the law were thrown around it, the bird life of the world in thickly populated countries would become practically extinct.

As matters stand today, the birds are protected by some effective laws. The sale of wild fowl is prohibited, and it is unlawful to shoot such game during the mating season. Also, the law imposes a "bag-limit"—this last an excellent provision so long as it is not made too stringent. Unfortunately in some States the limit imposed is practically prohibitive of hunting of any kind.

But the marshlands which are so essential in the migrating season are also threatened with extinction. This is due to the present craze for the reclamation of flooded lands by drainage; as the result of which millions of acres of some of the most famous nesting places of the birds have been changed into barren wastes, in which nothing useful to man is growing or even can be made to grow.

The SCIENTIFIC AMERICAN has ever been an earnest advocate of reclamation; but we believe that this, like any other good policy, can be carried too far. Some marshlands, doubtless, can be drained to advantage; but before dams are built and ditches dug, it should be proved by expert survey and investigation, that the land so recovered will raise crops, grow fruit trees, and house a farming community. Hitherto, too often no such care has been taken, with the result that some magnificent resorts of the migratory birds have been turned into dreary deserts.

This policy hits directly at the hunter of moderate means, to say nothing of "the one-gallus man"; and unless the Federal Government steps in, millions of hunstmen who, during the open season, supply their tables largely by the shotgun, will have to hang it up as a memento of a day that has passed.

There is now before Congress a "Game Refuge Bill," by which, through an annual license fee of only one dollar, it will be possible to finance the purchase and maintenance of sufficient natural feeding and resting grounds to preserve our migratory birds for all time to come. The bill has the backing of the American Game Protective Association, the Audubon Society, and practically all conservationist societies. We commend this measure to the support of both the bird lovers and the bird hunters of the country, who should be equally interested in its passage.

Is Oil a Mineral?

A CORRESPONDENT recently called our attention to an advertisement of an article in one of our prominent journals, in which oil was spoken of as a mineral, and asked us whether this was correct. As a matter of fact, no authority is prepared to state definitely whether oil should be spoken of as of organic or mineral origin. We asked the question the other day of the Geological Survey, and were told that nobody authoritatively knows; but they are inclined to believe that it may be derived from a vegetable or animal source, or from both. It is possible that in remote geological times during some convulsion, animal life, whether of the land or sea, together with much vegetable growth, died and was submerged with the sandy formation in which the oil is now found, and that the heavy petroleum oil which exists among the sandstone, limestone and oil-bearing strata represents what is left of these organic materials. This, however, is no more than a surmise.

But if there be some truth in this theory, how does it come about that oil is classed by the geologists as among the minerals? The answer is that it is found in mineral formation, and the process by which it is mined and recovered from the earth places it among the mining activities. Hence, it has come to be classed as a mineral. Some day investigation may establish its true origin, and it is possible but not probable that it will prove to be mineral in its origin. Until that time, it will be correct to speak of it as a mineral.

The Coast and Geodetic Survey

THE proposal to transfer the work of the Hydrographic Office to the Coast and Geodetic Survey forms part of the plans of the Government to secure economy by consolidating the bureaus, departments, etc., and so preventing wasteful duplication of work. With this effort we are in thorough accord—it is imperatively necessary. But in the transfer of activities, great care should be taken to insure, not only that the work will be done as well, or even better than before, but that the economy aimed at will be secured.

Judging the problem from these two standpoints, so far as it affects the Hydrographic Office and the Coast and Geodetic Survey we are still of the opinion that greater economy can be secured by abolishing the Coast and Geodetic and transferring its Geodetic activities to the Geological Survey and its Coast Survey work to the Navy. This proposal must not be taken as any reflection upon the character of the work that is being done by this office, whose excellence is everywhere recognized. But if economy is being sought, it seems to us that the division of its work between two existing government institutions that are fully qualified to carry it on is the logical solution.

So far as the Navy is concerned, the multiplication of bureaus and offices has been due, in part, to the persistent efforts in the past to take away from the Navy various of its activities. The Navy once was responsible for our lighthouses and the buoying of harbors. That was taken away and a separate bureau was created to do this work; and this in turn meant more personnel and increased cost. We suggest that if economy through consolidation is being sought, it would be well to abolish the Lighthouse Bureau also, and transfer its duties to the Navy, the excellence of whose lighthouse administration has never been questioned.

Here and There

EVERY year, the Franklin Institute, of Philadelphia, awards a gold medal for the best contribution to science for the preceding twelve months. It has been rather the custom, of late years, for this to fall in the field of atomic physics or that of electricity. The 1924 award, covering the achievements of 1923, departs from this precedent, and goes to a worker in surgery. The development of specific apparatus for surgical purposes —the application of invention to surgery, in fact—has taken long strides of late years; and nowhere is the spirit of this advance better exemplified than in the design, by William Gaertner of Chicago, of an injector for use in dosing with serums and in blood transfusion. It is this device which has been recognized as the year's outstanding contribution to science, and rewarded as such by the Franklin Institute Gold Medal. Mr. Gaertner, in the accompanying photograph, shows deep interest in something—we suspect that it is his ingenious serum injecting apparatus, rather than the medal which it has brought him.

William Gaertner

ONE of the most extraordinary surgical cases arising out of the war was recently reported from Australia. The patient was badly gassed, and while under treatment manifested indications that the poison effects of the gas were centering on his skin. In short time the entire epidermis peeled off his body, leaving him a mass of raw flesh. All efforts to graft skin or promote a new growth have failed. Contact of any sort is of course extremely painful. The patient has spent the last four years in a water bath, at carefully regulated temperature. Ingenious arrangements are provided so that he may sleep without danger of drowning—a fate narrowly escaped several times during the early history of the case. No hope for cure or even for alleviation is held out; but we gather that, aside from the obvious discomforts of his situation, the patient is in good health and fair spirits! The definite statement is made that the desire for relief through death no longer exists.

JUST by way of adding a little personal touch to the story that appears on pages 222 and 223 of this issue, we give here the photograph of Major F. L. Martin, squadron commander in charge of the four planes that will attempt the round-the-world flight. There seems to be some doubt whether the route outlined by Lieut. McDarment will be the one actually flown over, certain minor deviations being still under discussion. In particular, the fact that the four planes are now at Santa Monica, only fifteen miles from Los Angeles, has led to the substitution of the California city for Seattle as the official starting point, so runs the latest report. The plans as we go to press, too late to make any change in Lieut. McDarment's text, are for Major Martin and his staff to assemble at Santa Monica on March 1st, and to start the flight as soon as practicable thereafter. Seattle remains on the route, but will not be the first scheduled stop.

Major F. L. Martin

ONE of the questions which most inquiring minds have at one time or another considered is that of the most-used words. A systematic investigation of this has been completed by Prof. Carl C. Bringham, of the Princeton Department of Psychology. The leading places on his list of verbal best sellers are particles of one sort or another, as might be expected; but their order will in some respects be surprising The preposition "in" holds the ranking place, followed in order by and, that, a, the, to, with, be, of, as, all, at, not, for, on. It will be noted that "all" is the first entry of real adjectivial or nominal significance. Of true nouns, the most frequently used was found to be "time," and after it come day, man, place, year and work. The census of the words was a composite compilation from 625,000 words of juvenile literature, 3,000,000 from the Bible and English classics, 90,000 from the daily newspapers, 50,000 from books on cooking, sewing, farming and the trades in general, and 500,000 from correspondence. It would seem that the representative character of this array might be questioned—certainly few if any of us are concerned with the classics thirty times as much as with the daily paper. But whether a change of base in this respect would materially change the count might also be questioned. In any event, we have this count as the most authoritative answer of the moment to the question "What words do we use most?"

MANY estimates have been made of the annual damage done American crops through the ravages of insect pests; and various indeed are the figures in which this loss has been expressed. It must be so, indeed; for there can be no census either of insects or of insect depredations; any estimate must rest largely upon assumption and guess. We do not need figures, however, to convince us that the crops eaten and otherwise destroyed by insect life mount up to an alarming total every year. The boll weevil is perhaps the chief single item of concern, but his ravages are confined to the single crop. Where a voracious customer like the grasshopper occurs in large numbers, on the other hand, the agriculturist has no escape save by fighting the pest; for if not met and destroyed, it will wipe out all his crops. Our photograph shows Prof. M. A. Cobb, of the Bureau of Plant Industry of the Department of Agriculture, who figures in the news of the month by virtue of the great work which he has done toward freeing our farmers from this source of anxiety.

Prof. M. A. Cobb

ANATOMISTS who have explained the functions of the thyroid, pituitary and other ductless glands have been puzzled to account for the thymus, a small gland just above the heart. The Carnegie Station for Evolution at Cold Spring Harbor, N. Y., have found the answer. The thymus is one of those things that we have outgrown, but that have not yet disappeared from our anatomical structure. It is a relic of the days when the human ancestor was in the stage of evolution involving the laying of hard-shelled eggs. Experiments on pigeons showed that thymus deficiency led to the laying of fewer eggs, with absurdly thin shells, and with embryos that seldom survived the hatching process. The feeding of thymus extract to birds thus afflicted restored the egg-laying function to normal, both quantitatively and qualitatively.

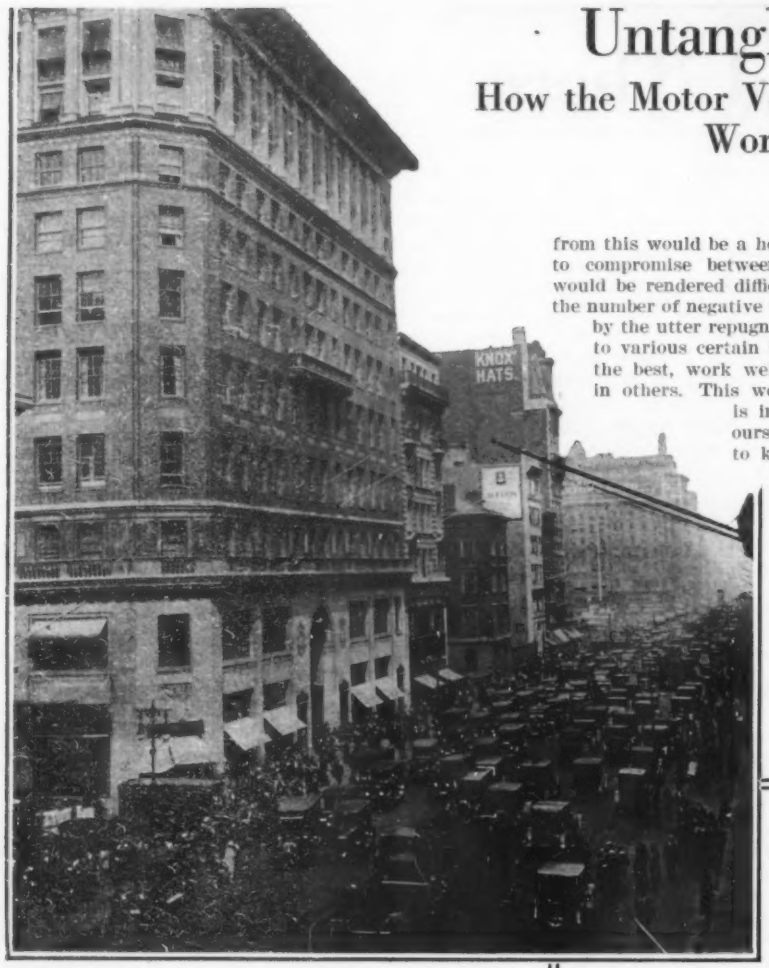
AMONG the interesting scientific oddities of the past weeks has been the first execution under Nevada's statute, enacted, if memory serves, several years ago, and specifying lethal gas as the instrument of capital punishment in the State. A Chinese murderer was the victim. He was shut in a gas tight chamber, and hydrocyanic acid sprayed into his atmosphere. Observations were made through a glass window, and it was agreed that the subject died instantly and painlessly. Movements of the head, which continued for some six minutes, were ascribed to reflexes similar to those of familiar frog's leg. It had been intended, as a measure of scientific interest, to make an effort at resuscitation; but the time which elapsed before the observers could safely enter the death chamber was so long that this would obviously have been futile, so it was not done. In addition to its scientific aspects, the case had an interesting legal side; the sentence was appealed to the United States Supreme Court on the ground that such a method of execution was a "cruel and inhuman" punishment, and therefore unconstitutional. The court refused to credit the claim that one form of painless death was more cruel than another, and dismissed the appeal.

Dr. John Roach Straton

MR. BRYAN is threatened with eclipse as the central figure of the evolution controversy. Two New York clergymen, whose portraits appear herewith, have recently been discussing this and other subjects in a series of joint debates, making a big hit with their auditors, with the press, and with the public at large. Dr. John Roach Straton is a Baptist of ultra-conservative hue; and Dr. Charles Francis Potter is a Unitarian and altogether a Modernist. Naturally they find plenty to disagree about, and when they meet the doctrinal wool flies freely. In a recent series of five debates, three dealt with topics of strictly theological interest; but one was explicitly on evolution, and a second was primarily concerned with the Biblical infallibility and hence involved evolution as the natural alternative to the first chapter of Genesis. The misunderstanding of the term which is so common was avoided by the adoption of the broadest definition, that of Le Conte: "evolution is a continuous progressive change according to certain laws and by means of resident forces." It is significant that in both debates the negative won. That is to say, when the question was (in effect) that the organic world had come into its present condition by the operation of evolution, Dr. Potter could not prove that it had, and Dr. Straton's case prevailed; but when the question put the burden of proof upon Dr. Straton requiring him to support definitely the infallibility of the Bible, he likewise found himself unable to shoulder the burden successfully. This probably represents rather well the present status of the issue between the literal interpretation of the Bible and the liberal reading demanded by modern science, with its ideas of evolution and its demand for millions, or billions of past years for evolution to have worked in.

Dr. Charles F. Potter

RADIO broadcasting continues to make progress month by month. Not only in the matter of program features, but in quality of reproduction the radio broadcasters have been steadily improving in their services to the great radio audience. It seems only yesterday that one of our editors went to the original WJZ station in Newark, and delivered a quarter-hour talk on science. The other editors secured radio sets for the occasion—one editor borrowing an airplane receiving set salvaged from some Army junk heap. It was a rare treat to hear our confrere talk over the radio. In the short space of two years this broadcasting business has become commonplace. Only a few weeks ago we heard the same editor speak from station WOR in Newark. So natural was the reproduction on our loudspeaker that we could even hear when our somewhat nervous confrere gulped down a glass of water!



Untangling Our Automobile Laws

How the Motor Vehicle Commissioners of Ten Eastern States Are Working Together Toward Uniformity

By the SCIENTIFIC AMERICAN *Staff*

ALWAYS the danger is present, when some proposal for legislative relief from an uncomfortable situation is being freely talked about, that the talk will exhaust the matter and there will be no action. The automobiling public, however, at least in the states named in this article, has every guarantee that the discussion of uniform motor-vehicle laws will not end in talk. The organization which we describe has made in two years a very large contribution toward uniformity. If the idea can but be introduced in all our states, and if we will but be satisfied with a gradual working toward the goal, it is the best means for remedying the intolerable conditions outlined in the preceding articles of this series, in the SCIENTIFIC AMERICAN *for January and February. In future issues we shall analyze the problem further, and show other means of promoting uniformity and of dissolving the present tangle into which traffic has got itself in our most highly motorized states. For the background of facts about which the present article is built we wish to acknowledge our heavy indebtedness to the kind cooperation of Hon. Robbins B. Stoeckel, Motor Vehicle Commissioner of Connecticut.*—THE EDITOR.

HAVING agreed upon the abstract proposition that our motor-vehicle and traffic laws ought to be approximately the same throughout the United States, and upon the concrete one that at this time they fall far short of such uniformity, the next point to be discussed is obvious. What are we going to do about it? Through what agency and under what jurisdiction are we to seek uniformity?

Several readers have taken up the argument here, to urge a Federal automobile and traffic law. To be sure, one's first impression would be that the way to have uniform law is to have one law, and that the way to have one law is to have Federal law. But more deliberate consideration casts doubt upon the wisdom of putting this problem in the hands of Congress.

The members of a state legislature are of two opposed political parties, and in addition they often divide sharply on the basis of city vs. country. But aside from these two points, they represent a fairly homogeneous and compact whole, with identical interests throughout the State. In almost every instance, a State is either a manufacturing or an agricultural or a mining one; its major road problem revolves distinctly about maintenance, or distinctly about original construction; it produces gasoline, or it doesn't; the manufacture of automobiles is, or is not, one of its major industries; its large cities are terminal points so that (like Massachusetts, New York and Pennsylvania) it profits from through truck traffic, or else (as with New Jersey and Connecticut) its position with respect to such traffic is substantially that occupied by Belgium in the war. On every major question of policy toward cars, trucks, gasoline, roads, taxes, and other automotive problems, a clean-cut decision can usually be reached as to where the best interests of the State lie; and a bill can be prepared and passed, dealing with any given point in such fashion as to conserve these interests. Then, when conformity with a nation-wide legislative standard is desired, well-considered and definite action can be had on every count; and failure to conform on some counts will have no influence whatever upon the possibility of conforming on others.

In Congress the case would be quite different. All the varied interests of the preceding paragraph, and many others, would be pitchforked into the one ring. Congressional discussion of any proposed uniform automobile and traffic laws would degenerate into an orgy of bickering and log-rolling. Any bill that might issue from this would be a horrible hodge-podge—an attempt to compromise between irreconcilables. Its passage would be rendered difficult or impossible by reason of the number of negative votes that would be necessitated by the utter repugnance of various of its provisions to various certain States. If enacted, it would, at the best, work well in some sections and poorly in others. This would not be Congress' fault—it is inherent in a country as big as ours. Our whole effort ought to be to keep issues that involve variant local viewpoints out of Congress, rather than throwing them into Congress as we so often do.

Speaking specifically of the automobile situation, we want substantial uniformity; but we must face the fact that complete uniformity on all features of the law, among all 48 States, is not possible. We must permit each State to determine for itself whether it can or can not conform on each proposed count.

Another major point would be that of taxation. The Federal Government already infringes rather largely upon the sources of taxation that are available to the States. Certainly the proposal to rob the States of the automobile license tax would be resisted to the last ditch. And so much of the machinery of automobile law and automobile administration revolves about the taxing and licensing powers and procedure that a Federal law with State taxation would be impracticable.

It might be urged that the Federal Government could administer the law and collect the taxes, apportioning these among the States. The weaknesses of such procedure are obvious, but we may pass over them and inquire about the enforcement and administration of a Federal traffic and tax law. Under the existing regime, the State administration and the State courts and the State police provide an efficient machinery for taking care of the automobilist in his contacts with the law. Were the Federal Government to take over this business, the States would perforce drop out. The Federal Government would be left holding the bag; and an enormous new clerical and judiciary machine would have to be built up, more than absorbing all the money that could possibly be wrung from the automobilist. Just one point to illustrate the impracticability of this proposal: would the traffic officer become a Federal appointee, outside the local police force; or would he remain a municipal policeman, regulating his busy street-corner under Federal laws and regulations, and appearing in Federal court against any offenders whom he might arrest or summons?

No: control of the automobile is essentially a State matter. Desirable as is uniformity, it is to be achieved, if at all, by action among the States. Offhand that sounds hopeless. It will doubtless surprise many readers to learn that steps toward voluntary cooperation between the States have already been taken, with results that justify an enthusiastic outlook upon the ultimate possibilities. The agency through which this progress has been achieved is one that has itself grown out of the automobile.

Historically, the motor vehicle became a problem in State administration only with the introduction of licenses. The attempt to keep up with the industry's growth has run substantially parallel in all States. Imposition and collection of the tax was originally in the hands of the Secretary of State, and that of enforcing the traffic laws became in the natural course of events a police matter. Ultimately the automobile license bureau grows into a separate administrative department of the State, under an official holding some such title as Commissioner of Motor Vehicles. Once this post has been created, much of the machinery of administration of the ordinary traffic laws gravitates into the incumbent's lap, because of the close tie-up between licenses and convictions; because of the necessity which ultimately appears of keeping the complete record of every car and every driver; and because of the unforeseen complexities and ramifications of the whole business of regulating the motor vehicle, which fairly demand a single, specialized administration.

The Motor Vehicle Commissioner is simply forced to be competent—if he isn't, the office very soon gets the better of him, and he makes way for a successor who is. He holds one of the most responsible places in the State administration, and his very tenure of office, if it does not break him, makes him an expert in his field. He goes to the legislature, asking for certain measures and telling why he wants them; and the law-makers give him what he wants on a liberal scale, because of the obvious disinterestedness and the obvious authority behind his requests. More than in any other department of the State administration, the Motor Vehicle Commissioner becomes the organ and mouthpiece of the entire State with reference to all things falling under his jurisdiction.

Well: wouldn't it be a good idea to get these Motor Vehicle Commissioners from the several States together once in awhile, get them to discuss and agree upon matters of common interest, get them to take the results of such discussion and agreement before their home legislatures? We have, every now and then, a more or less informal conference of Governors to attain harmony on matters of common importance. Wouldn't there be a very large prospect of unraveling a lot of the tangles now existing in our 48 traffic laws, by means of such conferences of the Motor Vehicle Commissioners?

There would be, most emphatically. And as a matter of fact, there is.

By invitation of the Tax Commissioner of New York State (who discharges the functions of Motor Vehicle Commissioner, so far as they are discharged at all in the Empire State under existing law), representatives of the motor-vehicle administrations of Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania and Maryland met on Sept. 23, 1921; and drew up articles of association under which, on November 18th, the Conference of Motor Vehicle Administrators was definitely organized for business. These articles set forth the membership of the Conference; they provide that each State shall be represented at each meeting by one or more members of its motor vehicle administration but that each State shall have a single vote; they create a President and Secretary of the Conference, and an Executive Committee; they provide

(*Continued on page 288*)

Houses of Mud

Old-Age Pisé Construction as an Answer to the High Cost of Building Materials and Labor

By Juanita W. Porter

SINCE Kansas City is to have the first house in America to be built of a material used in Europe for ages—pisé—the public is anxious to know something about this substance. Pisé: what is it? What is its origin, its appearance, its advantages as a building material—if it has any?

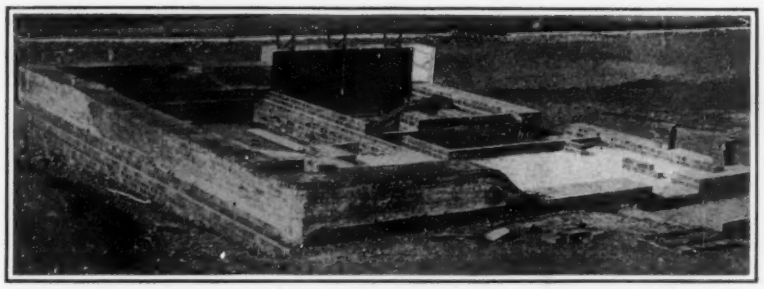
The structure to be made of the pisé is an English residence. A model farm may follow this experiment providing it comes up to the expectations of the builders. The house just being erected is one which promises much: it is Old English in type, is made of the pisé or rammed earth, with a stone foundation upon which are laid split railroad ties. Shingles of asphalt are to be used for roofing. A dividing wall in the grounds will be made of the same pisé material, coped with tiles.

Just what is pisé? It is merely the French for rammed earth, and rammed earth is an exceedingly good material for building walls, walls for buildings as well as walls for defense. The odd thing is that its very obvious merits should so far have received such small attention. The construction of buildings by this method is exceedingly simple, the earth being converted into walls by means of molds made of shuttering, into which the earth is rammed by means of a pisoir or rammer. The rammer is of the greatest consequence, as it is on the skillful handling of this tool that the firmness and durability and, in short, the perfection of the work, depends. Although it may appear very easy to make—and an amateur *may* make it if he follows directions carefully—more difficulty will be found in the execution than at first seems possible.

A frame to hold the earth is made of shuttering. The planks are light wood one-inch thick, each ten feet long and fastened together with four strong ledges on each side made two feet nine inches in height. This mold is divided into three divisions, each of which requires one workman. Of these three, however, only one needs to be a skilled workman, thus eliminating much expense. Into this mold earth is poured to the depth of three or four inches. It is rammed or beaten with the rammer until it is firm and hard and the rammer does not leave a print. All water must be pressed out of the soil. This process is repeated until the mold is filled; then the boards are removed and another tier is made on top of the wall just completed. A nine-foot wall can be made in a day. In fact, the building may be accomplished much more rapidly than by any other building process known, so it is claimed by the pisé proponents.

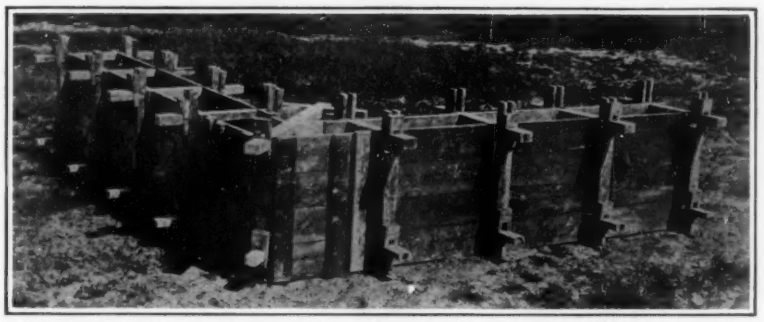
As regards the kinds of soil suitable for pisé building, all earths in general are fit for the use when they have not the lightness of poor lands nor the stiffness of clay. All earths fit for vegetation are suitable, as well as brick earths. Strong earths, with a mixture of gravel, which for that reason cannot serve for making either bricks, tile or pottery, are also suitable. These gravelly earths are very useful and the best pisé is made from them.

It is obvious that a person experienced in handling pisé must superintend, at least in part, buildings made of this material. So fast is this method gaining ground in Great Britain that improved machinery is being introduced to do the ramming of the walls and this will expedite the work. Meanwhile, the actual erection of pisé buildings presents so little difficulty that it can be done by anyone who has the strength to shovel earth and wield a rammer, provided he will exercise the care to see that the molds or boxes into which the soil is shovelled, are kept plumb and in straight lines. The pioneer settler, even with no previous knowledge of pisé, may work on his building if he has a well-thought-out plan.

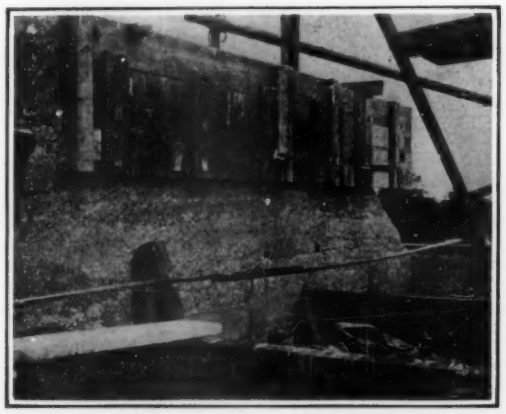


Start of a pisé wall on a brick foundation. At the back will be noted the molds in place for a section of wall

One difficulty in the use of pisé seemingly has been removed, namely, the long-supposed belief that the work could be done only in the warm season. In Canada, where the climate is rigorous more than half the year, structures erected in cold weather have been as free from cracks and as solid as those made in warm seasons. The consensus of opinion, however, is that it is better to build pisé houses when the weather is not too cold, thus eliminating an element of chance.

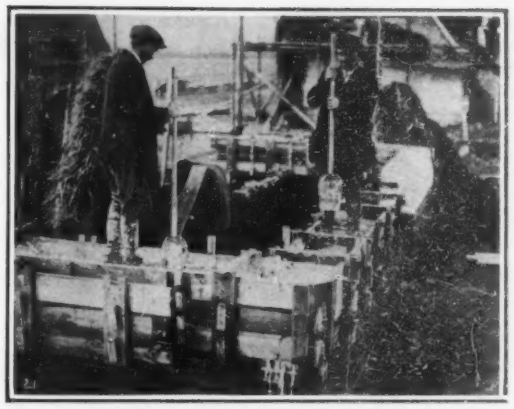


Typical sectional mold employed in pisé construction abroad. The heavy cross-members make the molds extra firm



Pisé wall in the process of building. The molds are shifted upwards as the construction progresses

In order that a test might be made by modern builders of this old art, a demonstration house consisting of six rooms and a barn attached, was erected at Guildford, England, several years ago. The walls, though 18 inches thick, cost less than $100 for the entire building, as against the cost of brick walls which would be $1000. A house of this size can be built in a fortnight, and it will last for generations. The test was so satisfactory that leading English architects have taken up the work of building pisé houses as one outlet, and a very important one, through the almost blank wall of building pessimism existing in England today. Indeed, it is largely through building with pisé that there seems any possibility of relieving the housing situation in those countries, where the shortage in lumber, brick, cement and almost every material needed in a house, with the added difficulty of the extortionate freight rates when those materials *may* be secured, drove builders to seek some substitute. It seems highly probable that pisé offers the much-sought way out of the dilemma.



Pisé construction under way: Ramming the earth in the molds until the moisture is pressed out

Official Government reports show that in Britain "raw timber is hardly obtainable and seasoned timber does not exist. The same is true of tiles, slates, corrugated iron and every other form of legitimate roofing substance. And, if these products can be found in the raw, all the brick-yards in Great Britain cannot half way supply the demand, since it will be five years before the output can equal what is needed *now* if those materials alone have to be depended upon."

Among the manifest advantages of pisé as a building material are: Its extreme cheapness. Untrained labor mostly can be employed. Besides this economic advantage, there is the saving of transportation charges, now such a bugbear to builders, since soil always is near at hand.

Comfort of pisé houses: Many degrees cooler in summer than even houses of brick; and warmer and easier to heat in winter than any other.

Practically indestructible: Records exist of houses built nineteen centuries ago and still in perfect preservation.

Small expense of upkeep: The doors and windows are the only parts requiring paint or replacement.

Practically fireproof: Since only the floors, windows and door casings are of lumber, and often even the floors are concrete, there is little to burn.

Another way in which pisé makes an appeal is its adaptability to many finishes. With either stucco or fresco—the latter a very inexpensive yet beautiful finish employed in France—a most beautiful exterior can be obtained. Such houses appear like far more costly residences. If a perfectly unadorned building is needed—such as a barn in a country place or houses to hold war supplies, pisé with *no* finish answers all needs of service and durability. The same building, with a coat of rough gravel, makes a more sightly building at a very little added cost.

A Static or Dynamic Atom?

IN *Nature* for April 28, Prof. W. R. Campbell says that some writers still contrast the static atom of Lewis and Langmuir with the dynamic atom of Bohr, as if the two alternatives were mutually exclusive. It does not seem to be realized generally, Prof. Campbell says, that any inconsistency there may have been between them has vanished completely with the publication of Bohr's later views on atomic orbits, since speculations about chemical constitution based on the *static* atom can be translated directly into the language and conceptions of the *dynamic* atom.

The fundamental idea of Lewis is that non-polar combination consists in the sharing of electrons between atoms in such a way as to complete stable electronic configurations. If the sharing of an electron means the sharing of an orbit, and if the stable electronic configurations are those in which the groups of highest quantum number are completed, as they are in the rare gases, then the Lewis-Langmuir theory, expressed in terms of Bohr's conceptions, states that such compounds are formed when some of the electronic orbits, instead of surrounding one nucleus only, surround both, and therefore help to complete the quantum groups of both. It is then merely a matter of linguistic alteration to interpret in terms of a dynamic atom conclusions which have been reached on the basis of the static atom.

The Story of Steel—IV

The Huge Blast Furnace, in Which a Fierce, White-Hot Fire Reduces Iron Ore to Pig Iron

THE enormous tonnage of ore brought down the lakes, totalling in a single year 56,000,000 tons, has to be disposed of quickly at the end of its journey. That part of it which is to be turned into steel on the shores of Lake Michigan and Erie, is loaded into huge stockpiles at the various steel works; and that which is to be converted in the Pittsburgh district is transferred by unloaders from the ore ships directly to railroad cars.

The vast steel plant at Gary on the southern shore of Lake Michigan contains the most up-to-date plant in the United States, and handles the largest amount of tonnage. Here the ore steamers enter an artificial canal, 22 feet deep, and 250 feet wide, which extends 4650 feet inland from the lake. The ore is discharged from the ships by ten Hulett unloaders of the type described in our March issue, which deposit it in a long trough parallel with the dock. Working in conjunction with them are ten Hoover & Mason travelling conveyer bridges. These huge structures are 500 feet in length, and each one carries a 15 ton grab-bucket. They dig the ore up from the trough and carry it back to a stockpile storage basin, from which it is taken, as needed, to the blast furnaces, 12 of which are arranged in a long line parallel with the stockpile. The storage yard, which is 4000 feet in length, has a capacity of 5,000,000 tons, which is sufficient to keep the Gary plant going during the winter months when navigation is suspended and no ore can be brought down.

Parallel with and back of the stockpile are twelve 550-ton blast furnaces, each provided with four hot-blast stoves; these are approximately the same height as the blast furnaces and but little smaller in bulk. Between the stockpile and the furnaces is a long line of elevated storage bins, in two parallel rows, one for coke and the other for ore and limestone. The material from these bins is delivered into electrically operated lorries which carry the materials to the furnace "skip", of which there is a pair to each furnace. The skips run up an inclined railway to the charging platform at the top of the blast furnace, each trip of the skip being made in sixty seconds and its average load consisting of 7000 pounds of ore, or 6000 pounds of limestone or 3600 pounds of coke. On its arrival at the top of the furnace, the skip automatically discharges its load into a hopper at the top of the furnace. Within the furnace are two cones. The contents of the skip falls upon the first cone, which is then lowered, allowing the materials to fall upon the second or lower cone. The upper cone is then drawn up sealing the exit, and the lower cone is lowered, discharging the materials into the furnace. This arrangement prevents any escape of the furnace gases.

The furnace once started is kept going continuously night and day month by month, and year by year, until repairs become necessary. There are furnaces which have a record of several years continuous operation. The drawing on the opposite page and the text which accompanies it explain very clearly the operation of the furnaces and the process by which the iron is separated from the ore and collected at the bottom of the furnace. The air for combustion is introduced at the bottom of the furnaces through a series of water-cooled tuyeres which enter the furnace near the top of the hearth. An enormous quantity of air is required for each furnace and this is supplied by huge blowing engines, located at a distance from the furnaces. The air enters at an average pressure of 18 pounds per square inch.

The hot furnace gases are led by a large pipe from the top of the furnace into a dust catcher, and after being cleaned in a washer, they are led through the hot stoves, of which there are four to each furnace, as shown in our wash drawing and in the line drawing on this page. The stoves are cylindrical, plate-steel structures, entirely filled with a honeycomb of firebrick. As the gases enter the stoves (two stoves are heated at a time) a certain amount of air is fed in with them, and the burning gases, as they pass through, raise the firebrick within to a high temperature. When the proper heat is reached, the gases are turned into the adjoining pair of stoves. At the same time the cold air from the blowing engines is caused to enter at the bottom of the now heated stoves and, in passing up through the honeycomb, it takes up the heat previously given up by the furnace gases, and enters the blast furnace at a high temperature, thus restoring to the furnace a large measure of its heat.

The operation of the blast furnace, as we have said, is continuous, and the temperature varies, as shown in the accompanying page, from that of the molten iron (3500 degrees) in the hearth at the bottom to that of the cold charge as it is fed in at the top. At regular intervals the slag and the hot metal are separately drawn off into large ladles, the slag being hauled away to be crushed and utilized in the cement mills, and the hot metal being hauled to the mixers and thence to the Bessemer converters, or to the open hearth furnaces, as will be described in subsequent chapters of the present series.

Referring again to the drawing on the accompanying page, it should be explained that the two right-hand stoves are being heated by the burning gases, which are led in and ignited at the bottom, the valves from the cold air pipe just below being closed. At the top of these two stoves, the valves opening to the hot blast pipe are closed and the products of the burning gases are passed out through the tall smokestacks above the stoves. At the same time the valves opening from the cold-air duct at the bottom of the two left-hand stoves are open; the gas valves just above them are closed; the valves controlling the smokestacks are closed; and the valves opening to the hot-blast pipes are open.

In laying out the Gary plant, it was possible to utilize all the past experience in the steel industry and effect large economies. Chief among these is the utilization of the blast furnace gases for raising steam in batteries of boilers; in operating gas engines for running the furnace blowers, and other gas engines for operating generators for the supply of power and light and for the vast Gary plant. There will be some among our readers who, like the writer, remember the time when no attempt was made to save the enormous and valuable volumes of gas which poured out of the top of the blast furnaces. The first attempt to save part of these gases was to burn them underneath steam boilers and secure power for the operation of the blowers, etc., by steam engines. The latest development is that carried out at Gary. The diagram which we present gives the distribution now made of the furnace gases, of which the twelve furnaces at Gary produce *every hour* 40,300,000 cubic feet. Of this total amount 30 per cent is used in heating the hot stoves. The steam power plant uses 7.5 per cent. The primary washers for the hot blast stoves and the secondary washers to clean the gas again before it goes to the gas holders, uses 2.5 per cent of the gas. Then the great blowing engines use 15 per cent, and the remaining 45 per cent is available for running the gas engines in the electric power station. The gas, as purified, has an average heat value of 90 British thermal units per cubic foot, and it is estimated that two and one-half times as much power can be derived from a given quantity of gas with gas engines as can be secured with boilers and steam engines. The blast-furnace gas serves to operate fifty-seven 2500 to 3000 horsepower gas-driven generators and blowing engines.

Returning now to the process of reduction in the blast furnaces, the limestone is used to "draw" the silicon, sulfur, manganese, alumina and other ingredients, except phosphorus, out of the melting iron. In this process there is formed a frothy substance (which includes ashes of the burning coke and various products of combustion which do not escape with the gas) which floats on the top of the molten iron. This is the slag. Practically all the phosphorus, much of the sulfur, about three quarters of the manganese, and more or less silicon will remain in the molten iron. It is the alumina, lime, and other ingredients of the ore that form the slag.

Coke is used almost exclusively in the blast furnaces of the United States. It is made by baking bituminous coal for 48 hours in closed ovens, two-thirds of a ton of coke being produced from a ton of coal. The blast furnace coke must have special qualities. It must be strong enough to sustain without crushing the huge burden of 1500 tons of the load in the furnace. It must be porous, so that the hot blast may pass freely through it. It must be very pure and burn with very little ash. Coke consists of about 88 per cent carbon, and it is the burning coke together with the red hot blast as it comes from the stoves, which completes the final process in the lower part of the furnace of melting the iron and the slag. The pig iron, as tapped from the furnace, contains from three and one-half to four per cent of carbon which is subsequently reduced in the Bessemer converter.

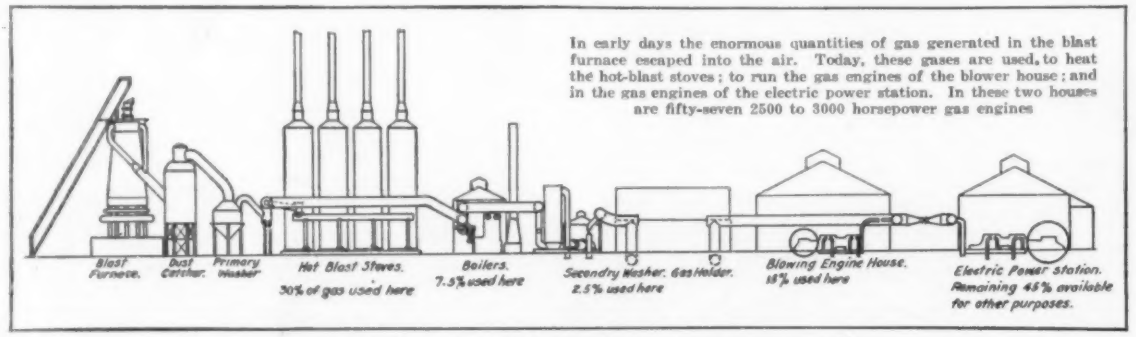

In early days the enormous quantities of gas generated in the blast furnace escaped into the air. Today, these gases are used, to heat the hot-blast stoves; to run the gas engines of the blower house; and in the gas engines of the electric power station. In these two houses are fifty-seven 2500 to 3000 horsepower gas engines
Blast Furnace.
Dust Catcher.
Primary Washer
Hot Blast Stoves. 30% of gas used here
Boilers. 7.5% used here
Secondry Washer. Gas Holder. 2.5% used here
Blowing Engine House. 15% used here
Electric Power Station. Remaining 45% available for other purposes.

Diagram showing the distribution of the furnace gases at Gary

Water from Gasoline in Airships

THE cruising radius of airships, such as the great navy dirigible "Shenandoah," will be greatly increased in the light of an invention now approaching completion as the result of months of study by the government's aeronautical and scientific experts. The device makes it possible for the ship to burn up its store of gasoline without loss of weight and without increase of buoyancy. This will result in the saving of many thousands of dollars worth of expensive helium gas that lifts the ship and which otherwise would have to be released and wasted to keep it from rising to dangerous heights.

Gasoline is composed of carbon and hydrogen. When burned, the products are carbon dioxide, carbon monoxide and water vapor. The first two gases escape. The last is condensed. Since gasoline requires more than three times its weight of oxygen for complete combustion and since about a third of that goes to form water, the weight of the condensed water is somewhat greater than that of the original gasoline. This keeps the weight of the airship constant and makes unnecessary a loss of the lifting gas, which heretofore has been a feature of long flights. In an airship without the condensing device, the craft grows lighter as the voyage progresses owing to the consumption of the liquid fuel. This results in the airship's rising higher and higher until in the interest of safety some of the buoyant gas has to be liberated. This reduces the reserve buoyancy if unfavorable conditions are met, and so curtails the length of flights.

Airships of the future equipped with the compensating water condensation device will be able to carry up fuel in quantity only limited by the buoyancy of the craft and the requirements of space, and will be able to burn it without releasing a compensating quantity of the precious helium gas.

Water condensation apparatus will be installed on the "Shenandoah," formerly the "ZR-1," before long flights through the polar regions or elsewhere are attempted, according to present plans of the government experts. If the airship of commercial type, the "ZR-3," which is now being built for the United States by the German government, is successfully delivered to this country, it also will be equipped with the new invention.

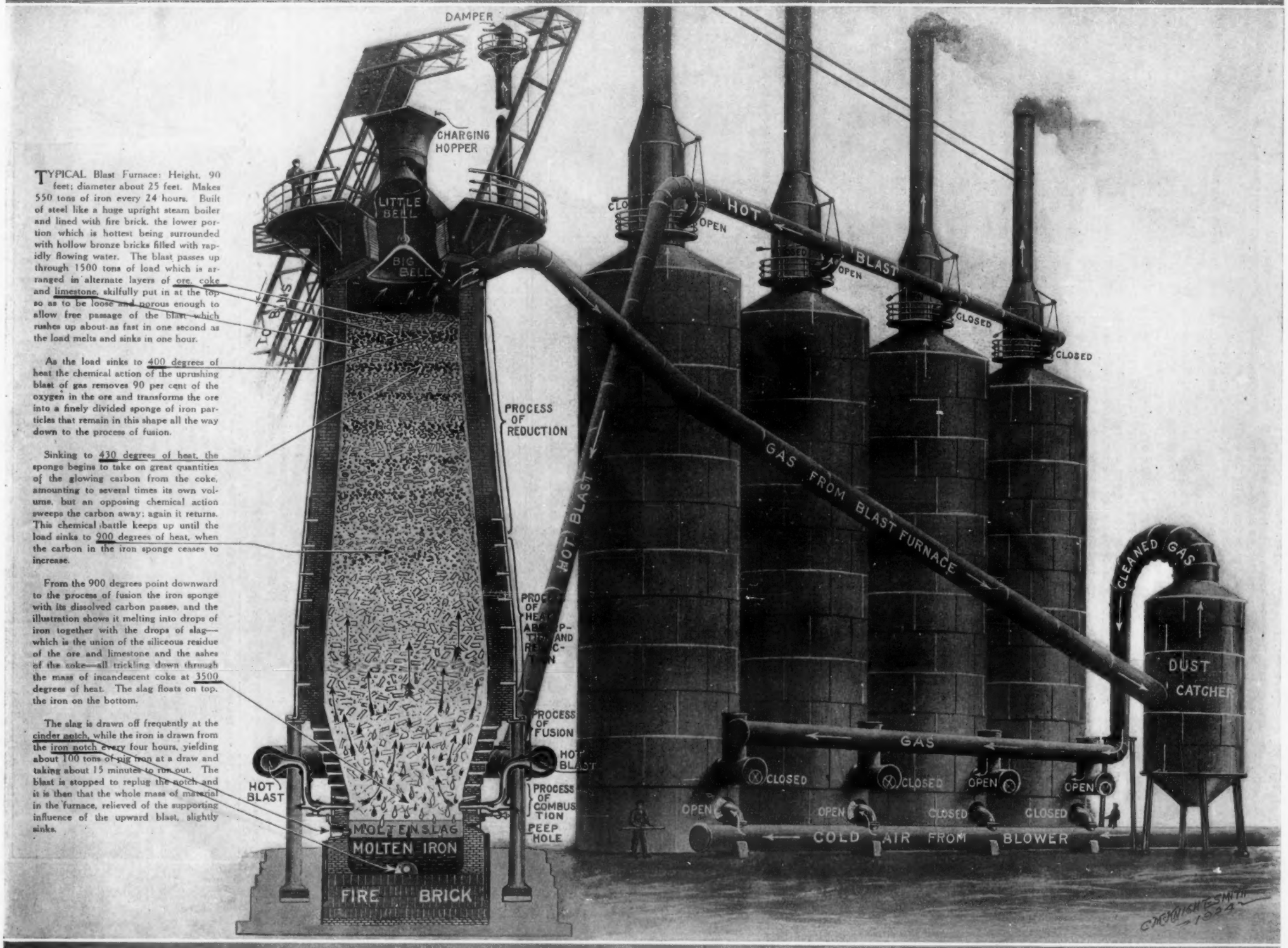
TYPICAL Blast Furnace: Height, 90 feet; diameter about 25 feet. Makes 550 tons of iron every 24 hours. Built of steel like a huge upright steam boiler and lined with fire brick, the lower portion which is hottest being surrounded with hollow bronze bricks filled with rapidly flowing water. The blast passes up through 1500 tons of load which is arranged in alternate layers of ore, coke and limestone, skilfully put in at the top so as to be loose and porous enough to allow free passage of the blast which rushes up about as fast in one second as the load melts and sinks in one hour.

As the load sinks to 400 degrees of heat the chemical action of the uprushing blast of gas removes 90 per cent of the oxygen in the ore and transforms the ore into a finely divided sponge of iron particles that remain in this shape all the way down to the process of fusion.

Sinking to 430 degrees of heat, the sponge begins to take on great quantities of the glowing carbon from the coke, amounting to several times its own volume, but an opposing chemical action sweeps the carbon away; again it returns. This chemical battle keeps up until the load sinks to 900 degrees of heat, when the carbon in the iron sponge ceases to increase.

From the 900 degrees point downward to the process of fusion the iron sponge with its dissolved carbon passes, and the illustration shows it melting into drops of iron together with the drops of slag—which is the union of the siliceous residue of the ore and limestone and the ashes of the coke—all trickling down through the mass of incandescent coke at 3500 degrees of heat. The slag floats on top, the iron on the bottom.

The slag is drawn off frequently at the cinder notch, while the iron is drawn from the iron notch every four hours, yielding about 100 tons of pig iron at a draw and taking about 15 minutes to run out. The blast is stopped to replug the notch and it is then that the whole mass of material in the furnace, relieved of the supporting influence of the upward blast, slightly sinks.



TYPICAL MODERN BLAST FURNACE GROUP, SHOWING THE BLAST FURNACE, IN SECTION, WITH ITS SET OF FOUR HOT-BLAST STOVES

Our Psychic Investigation

A Summary of Results to Date, and a Plea for Better Mediumistic Cooperation

By J. Malcolm Bird

Secretary to the SCIENTIFIC AMERICAN Psychic Investigation Committee

OUR February issue carried a summary of the conclusions reached to that date in our investigation of the electronic reactions of Abrams. This was wholly in order. All electronic practitioners are doing the same thing in substantially the same way. The question of personal fraud enters so slightly that conclusions drawn from experiments with one disciple of Abrams may fairly be charged or credited against another. But in the psychic field, each medium is an independent problem. While a single successful demonstration would be sufficient to show that the objective phenomena of psychism occur, one would need a large number of experiments with a large number of fraudulent operators, covering a wide range of phenomena and including no doubtful cases whatever, before one would be justified in drawing a negative conclusion.

Nevertheless, it is possible to review in some sense what our psychic investigators have accomplished in fifteen months, and to make from their experiences a few remarks of general applicability. But first we must dispose of a few loose ends from our latest cases.

Our brief against Mrs. Y., the flower-writing lady, as given in our December issue, was convincing enough to most readers; but of course there were those prepared to amend or reject it. One of these was Sir Arthur Conan Doyle. The obvious impossibility of setting down on the printed page every last detail left Sir Arthur without certain facts which turned out to be of essential bearing upon the questions which arose in his mind. Hence he found our report in some respects incomplete, in others a bit self-contradictory; and he felt that our procedure and perhaps also our conclusions had in some points violated common sense.

One always expects Sir Arthur to make his opinions openly known; and this he did, with lengthy critiques in the *New York Times* and in *Light*, the London spiritualistic weekly, as well as by direct correspondence. Replying to the printed comments in print and to the direct letter in kind, we were able to supplement Sir Arthur's knowledge of the case; and he himself unearthed data of bearing. Finally, the medium was so ill-advised as to write to him, making statements which must necessarily be false if we ourselves are in good faith. As a result of all this, Sir Arthur now states, in the columns of *Light*, that his doubts are resolved and that we are entirely justified in our conclusions; and to us he writes, in part:

"I am forced to the conclusion that your judgment has been correct. I am bound to act as counsel for the defence as far as I honestly can, but I am equally bound to admit it when I find that the case is indefensible. I am now grateful to your Committee for having exposed a wrong one. I hope a right one may come your way."

Sir Arthur has been accused of blind credulity. His own characterization of his attitude as that of volunteer counsel for the defence will be sufficient refutation of this, and complete justification for his slowness to accept the hypothesis of fraud in any given case and his eagerness to see that every possible ground of doubt be thoroughly threshed over. His statement in this case ought to dispose of all excuse for failure properly to appraise our evidence against Mrs. Y.

We spread these facts upon the record with no desire to harass Mrs. Y., but simply because she drives us to it. On the appearance of Sir Arthur's long critique of our findings, and using this as her sole text, the lady "challenged" us to grant a review of her case, before a Committee which should be chosen in half by herself and should sit in her home city. She has used this challenge as a means of getting her name and ours in the papers; and she promises, in the event that we decline or ignore it, to go still further in this direction. We regard Sir Arthur's acceptance of our original verdict as a complete answer to this "challenge," and take this means of making plain the facts in the case. If Mrs. Y. wants redress, we fear that she will have to make good on her threat of six months ago to sue us for libel.

So much for Mrs. Y. Just a word of humorous backfire from Mrs. Tomson, the medium who "ran out" on us at the last moment. According to advertisements in the Chicago papers, she is doing business at the old stand—'phone for an appointment. At the end of her three-inch insertion is found a word of warning to the faithful: "Pay no attention to false stories of jealous people or publications. Mrs. Tomson's seances in New York were great triumphs. Proofs on file in our free reading room."

So that's what's the matter with us—we're jealous! Perhaps, some day, we shall seek a cure in Mrs. Tomson's free reading room.

Coming down to the Pecoraro case, we must present an alibi for Dr. Vecchio. We stated that, if Nino won our money, Dr. Vecchio expected to be the beneficiary. This was based upon Dr. Vecchio's remarks to a *New York Times* reporter, made in our office and in the presence of members of our staff. Dr. Vecchio reminds us that this interview was given in Nino's presence, and was punctuated by conversation in Italian between himself and the medium. He grants that he turned to the reporter and said: "I have won the money, and I want it;" but he states that he was translating what Nino had just said to him. Dr. Vecchio feels that the statement as published reflects seriously upon him; and though we are inclined to think that at its worst it would merely indicate that Nino is a sort of peon of the doctor's, we are very glad to present this modification.

At other points in our story, we criticized Dr. Vecchio's conduct where we felt that such criticism was in order. Dr. Vecchio insists that he is a scientist and an investigator, interested only in the truth. One present at the seances and not having heard this would certainly take him for a very active protagonist of the medium. But we are prepared to believe, and in fact we have at all times believed, that this inconsistency between speech and action is unintentional on the doctor's part. He feels that our unfavorable comments upon his behavior might be taken by our readers as an attack upon his good faith; so we hasten to repudiate any such intent. We had no idea whatever of charging him with anything more serious than extremely poor judgment.

On the Pecoraro case we have had more comment from our readers than on any other; and this comment is almost evenly balanced. Half of those who write blame us for not tying Nino up tighter, and the other half blame us equally for having tied him so tightly. Presumably this would indicate that the way we did it was approximately right; but even so, a few words of explanation here are in order.

Those who write letters to us on this subject are blessed with a fund of positive information which the researcher may well envy. The one group state categorically that the materializing medium must have a decent degree of freedom within his bonds, or the materializing forces are absolutely inhibited. The other are equally positive that the medium may be rendered completely immobile without the slightest prejudice to any materializing powers which he may possess. With our best respects to the proponents of both these theories, we are unable to find the slightest justification for any categorical opinion on the point, which we believe could be settled only by catching a genuine materializing medium (we assume for the purposes of argument that there is such a person) and trying it out.

We were quite aware of the objections, from the one side and from the other, to the procedure which we adopted in our four sittings with Pecoraro. Had we had complete freedom of action, we should have adopted many of the devices which are suggested by our correspondents, and many which they do not appear to have thought of. We should have tried the effect of substituting fine sewing thread for the ropes and wires. We should have tried the effect of sealing the medium in his place with sticking plaster, etc. We should have tried the effect of a wire and of a textile screen between him and the apparatus. We should have tried the effect of handcuffing him to his chair. We should have tried the effect of putting him inside a muslin bag, and smearing the apparatus with black cold-cream (made so by addition of lamp-black—rendering it a fearful and wonderful mess); the expectation would then be that if the phenomena are genuine the smears would be mainly on the medium inside the bag, whereas if they were done by normal use of his hands through the fabric of the bag, these smears would be entirely on the outside of the bag. And we should have tried a lot of other things which we do not consider it expedient to put down in black and white at this stage of the game.

One never has absolute freedom of action in dealing with a medium, however. One always comes to the place where one must choose between the abandonment of the conditions which one would desire, and abandonment of the entire investigation. With Nino, we came to this point early and often, whenever any proposal was advanced to vary the conditions from those to which the medium is accustomed in his routine sittings with his friends. If we had felt it impossible to proceed without the desired conditions, we should not, of course, have waived them. But the sacrifice of these conditions involved merely our own inconvenience and a certain amount of precision of procedure; all necessary information to determine the character of the manifestations could be obtained in the way we obtained it.

Further sittings, however, regarding which we expressed a provisional willingness, are something else. There will obviously be no profit at all in sitting some more with the same old silly arrangement of Nino's arms and hands. Dr. Vecchio fails to see this, fails to understand the necessities of scientific investigation, fails to realize that in the end the investigators must have their way or abandon the matter. He talks and writes only of the conditions under which he will "allow" us further sittings. So we have very definitely told him that there won't be further sittings with Nino; that this chapter is closed.

If one examines our experiences of the past fifteen months in search of a generalization, one must be struck by the lack of quality in the mediums who have come forward. "Mr. X" was unknown outside the section of Pennsylvania in which he was operating. "Mrs Y" is fairly well known in spiritist circles in the Middle West, if only because of her conviction and expulsion as a fraud some years ago; but her name meant nothing to the general public. Neither did Nino Pecoraro's, and from the spiritualist viewpoint his work is very crude. Mrs. Tomson has some place in the public mind, but not one of which she is likely to boast.

Compare these names with those of William Hope and Evan Powell; of Frau Silbert and the Schneider brothers; of Erto and Franek Kluski; of Ada Besinnet and Mrs. Wriedt and the Jonsons. Plainly the "mediums" who have come before us are far from the

(Continued on page 291)

IT HAS been a matter of severe disappointment to us that, to date, our psychic investigation has attracted only mediums who have turned out to be of small genuineness or none at all. In order that there may be no material obstacle in the way of participation by any medium of high caliber, we now make this offer: To any such medium we will secure passage to New York, maintenance here for the necessary period, and passage home; and in the event that the medium accepting this offer fails to win our $2500 award, the money thus disbursed need not be repaid. The offer applies to the mediums Hope, Powell, Kluski, Erto, Willy and Rudi Schneider, "Stella C.," Frau Silbert, Mrs. Deane, Miss Besinnet, Mrs. Wriedt, and Jonson; as well as to any unnamed medium who proves worthy of consideration.

A Telescope of Record Dimensions

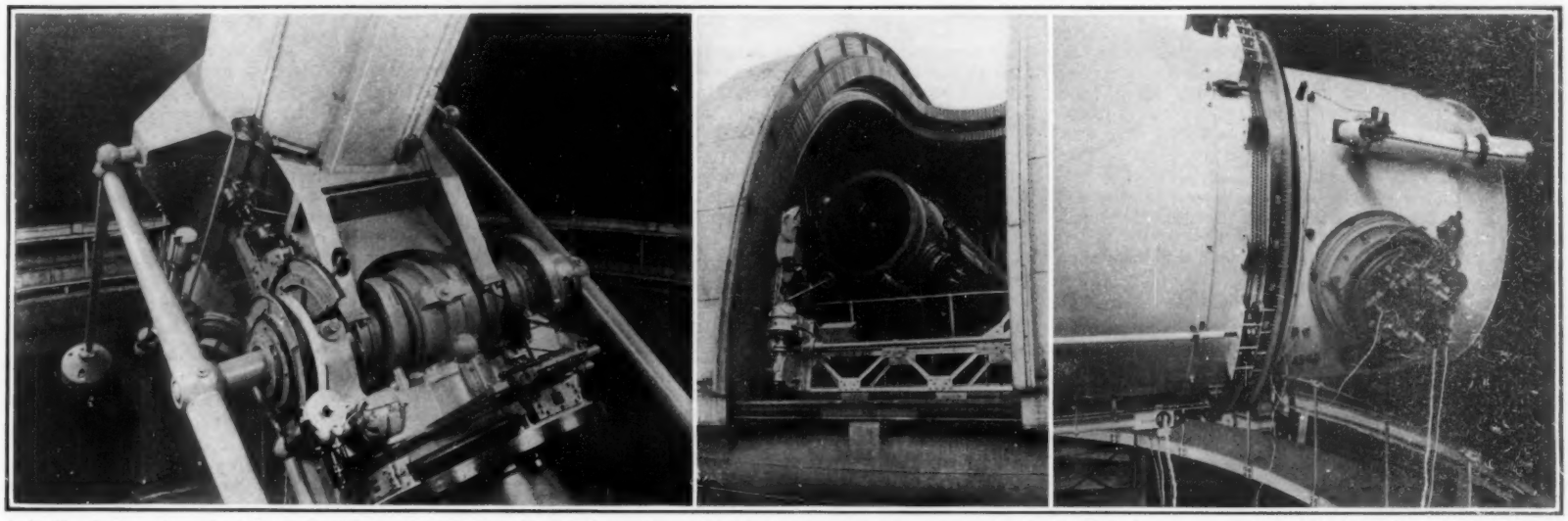
By Our Berlin Correspondent

WHAT purports to be the largest and most powerful reflecting telescope in Europe has recently been constructed by the Zeiss firm of Jena, Germany, and installed at one of the principal German observatories, that of Neu-Babelsberg, near Berlin. This is surrounded by a huge cupola thirteen meters in internal diameter, rotating round its axis and comprising a slot three meters wide. Apart from the principal mirror 1250 millimeters in diameter, there are two auxiliary mirrors used alternately, according as the telescope is employed either on the Newton or on the Cassegrain system, the focal distance being 8.4 meters in the former case and 24 meters in the latter. Provision is made for visual and photographic observation as well as for spectroscopic work.

The auxiliary mirror used with the Newton system is fitted to the front end and into the axis of the tube by means of two steel bands in its interior. This is a plane mirror of elliptical outline (400 × 300 millimeters), the fitting and attachment of which with a spherical balancing weight is visible in the second picture below.

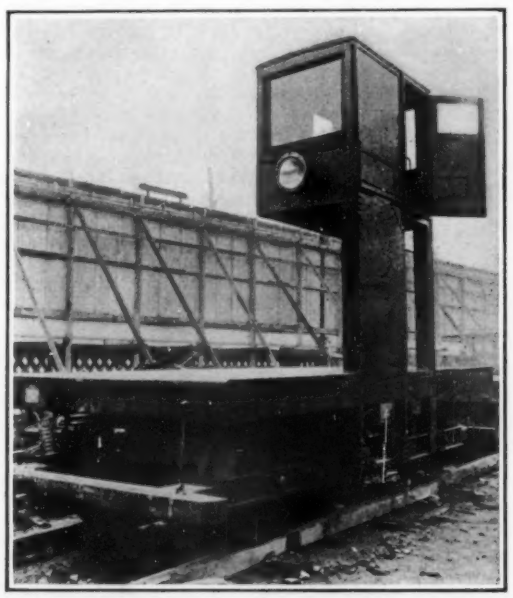
When arranged on the Newton system for photographic work, the adapter is fitted with cross-slide and two spectroscopes, thus allowing the daily motion of the instrument to be checked most accurately. This front end of the tube can be imparted any rotation round its axis by means of a hand-wheel visible at the underside of the telescope, thus enabling the adapter arrangement and the searcher of 100 millimeters opening, situated above, to be readily attained by the observer. Electrical button switches visible to the left of the adapter control the fine adjustment of the instrument. There is also a mechanical fine adjustment, independent of the other and simply actuated by means of a hand-wheel.

The reflecting telescope is fitted with a double system of guiding and balancing axes. The balancing axes enable the movable parts of the telescope to be arranged sideways to the stationary column, thus allowing the telescope tube perfect freeness of motion in all directions.



Left: The double system of guiding and balancing axes. *Center:* The auxiliary mirror at the front when the telescope is used with the Newtonian arrangement. *Right:* The set-up for photographic work, showing the adapter with its cross-slide and two spectroscopes

Three views of Germany's newest and largest telescope, an all-around astronomical tool of unusually wide range



Wooden rails in the Oregon lumber camps

Shrouding the Propeller

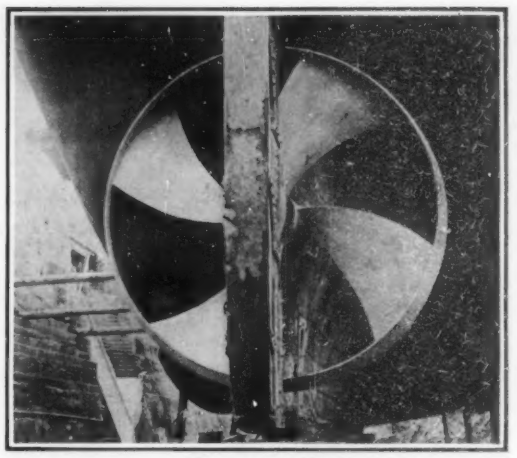
THE open type of screw propeller is an instrument whose principles of design have long been known by engineers. Today it is possible to predict the performance of a correctly designed open screw with remarkable accuracy, provided the performance is made under ideal or laboratory conditions. Such a propeller, when mounted on a ship and sent to sea meets with varying conditions of work, constantly varying draft, etc., so that it usually becomes necessary at some loss in efficiency to use a type of propeller which is the most economical compromise between the dictates of theory and of practice.

The shrouded propeller has been designed, according to its English manufacturer, to make its own conditions with the water. The shroud consists of a band fixed to the outer end of the blades, and this band has a fore-and-aft taper, so that the stream produced by the propeller is confined. In addition, the working pitch of the blades increases axially. Owing to these two facts there is a regular acceleration in the stream acted upon. A typical open propeller, with a shroud fitted to it would not constitute a satisfactory propeller. It would be so large that it would overload the engine, the shrouded propeller usually being made 10 to 15 per cent smaller in its determining proportions than an open screw for the same installation. Again, such a propeller would lose much of its efficiency. It is stated that the shroud of the new propeller takes the place of the surface of tearing and eddies which in the usual screw surrounds the stream of water directly acted upon.

The distinguishing feature of this shrouded screw is that it causes all the water acted upon to be thrust astern instead of in a divergent direction, the latter effect being due to a centrifugal force. This introduces the subject of "slip" and it is stated that a propeller whose advance through a solid nut would be about one and a quarter times that of the actual forward advance of the ship is, generally speaking, more efficient than one with less "slip." In this sense the shrouded propeller is less wasteful in attaining the requisite value of slip than are open screws.

Another advantage of the shrouded propeller is evident when working under very shallow conditions, for it is very much less likely to "break water" than the open screw. It also develops the merits of the broad tipped blade without incurring vibration. It obviates "squatting" at the stern and leaves a relatively smooth propeller wake, the latter being a very valuable attribute in the case of vessels operating in canals and other waterways of restricted area.

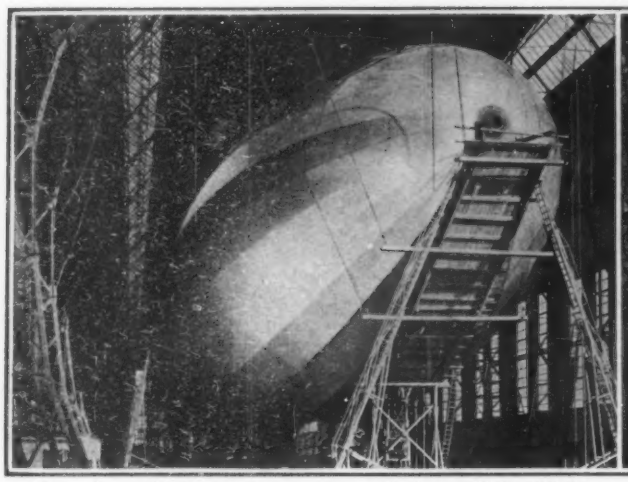
The commonest objection to the shrouded propeller is that the shroud occasions increased friction due to its drag. However, it is claimed that considerably more useful effect is produced by the shroud than is lost by its surface friction. Another objection frequently raised is that the shroud should be fixed, with the propeller rotating within it. But such an arrangement would be unsound hydraulically on account of excessive eddy losses. In practice, it has been found that if any solid objects it meets are too large to go through the opening, they are thrown off. In short, in meeting these objections, the proof of the propeller is in the propulsion, and the shrouded propeller is stated to have produced towing results five per cent better than those attained with the best open propeller available.



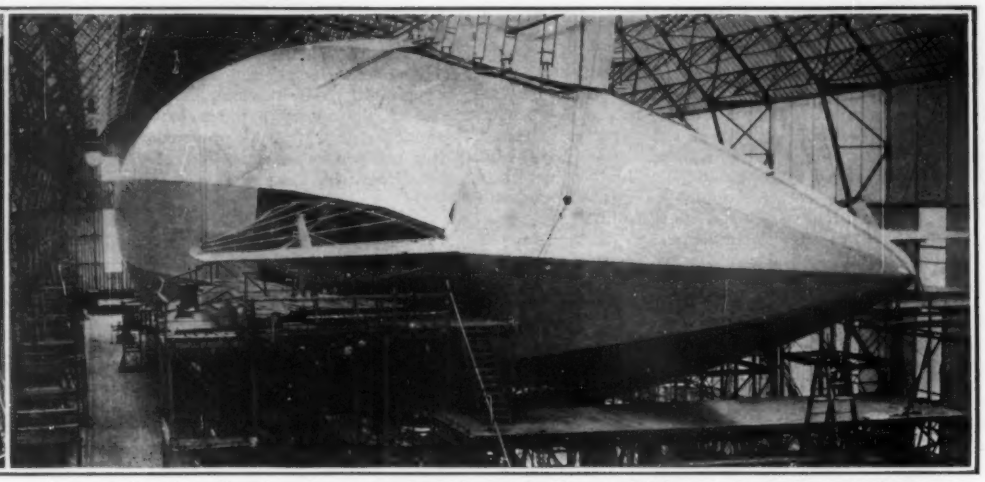
The shrouded propeller, which throws all the water directly astern, without any divergence or centrifugal action

Wooden Rails Where Wood is Plentiful

FURTHER confirmation of the rumor that "there's nothing new under the sun" comes to us out of the woods of Oregon. A large lumbering concern in the interior of this State, requiring short-line logging railroads of a temporary nature on a rather liberal scale, laid these down, using wooden rails. For this purpose big planks six inches square were employed: and the cars were equipped with solid, rubber-tired wheels, the flange effect being obtained by a separate inner wheel, of larger diameter and flat surface, bolted to the wheel that bears upon the top of the rail. We get the impression from the picture in the first column that these inner members do not reach the axle at all, overlapping the main wheels merely by a sufficient margin to carry the bolts, but of this we are not certain. Our introductory remark arises from the fact that the very first railroads, back in the days when Stephenson and his contemporaries were monkeying with the steam engine much as Olds and Haynes and others were monkeying with the gas engine in the early nineties, were laid with wooden rails—and they weren't any six-inch-square rails, either. In fact, the wooden rail goes right back to the days when the present function of the locomotive was discharged by the humble mule. Its use in the Oregon woods is therefore a reversion of much interest.



Bow view of "ZR-3," now near completion, which will fly from Germany to America this spring



Stern of the ship, showing strong construction of the fins. "ZR-3" is to be used purely for passenger and light freight service

Largest and Fastest of the Zeppelins

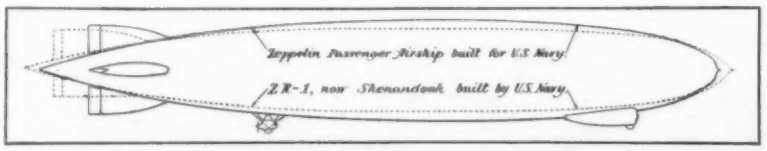
New German-Built Airship for the Navy, Soon to Set Sail for the United States

THERE is now approaching completion at the works of the Zeppelin Company at Friedrichshafen, an airship, known for the present as "L. Z. 126," which is to become the property of the United States as part of the reparation payments. The ship has been built to the limit of size imposed by the Allies; that is to say, it is not to exceed in size the largest of the Zeppelins built during the war. Although the lines of the ship are similar to those of the latest wartime Zeppelins, it contains some modifications suggested by the operation of two passenger ships, the "Bodensee" and "Nordstern," which were built and operated in Germany after the Armistice. It is the largest airship in existence. It has a capacity of 2,472,000 cubic feet of gas; the length over all is 656 feet and the diameter amidships is 90 feet. One of the conditions imposed by the Allies when this ship was turned over, was that she should not be used for war purposes. Hence she will be delivered to our Navy Department with the understanding that she will be used only for the development of commercial aviation, and in experimental work to promote the general advancement of airship construction and navigation.

To enable our readers to judge for themselves the difference in the size and form of the two ships, we present a drawing in which the profile of one ship is placed over that of the other, "Shenandoah" being shown in dotted lines and the new ship in full lines. It will be noticed that the new ship is of blunter form, and is more completely streamlined, that is to say there is no section of the hull where the hull is not curved, the streamline form running unbroken from stem to stern. She is 24 feet shorter than the "Shenandoah," but is larger in diameter by 11¼ feet. The fins and vertical and horizontal rudders are placed relatively further forward, and their construction is noticeably more rigid.

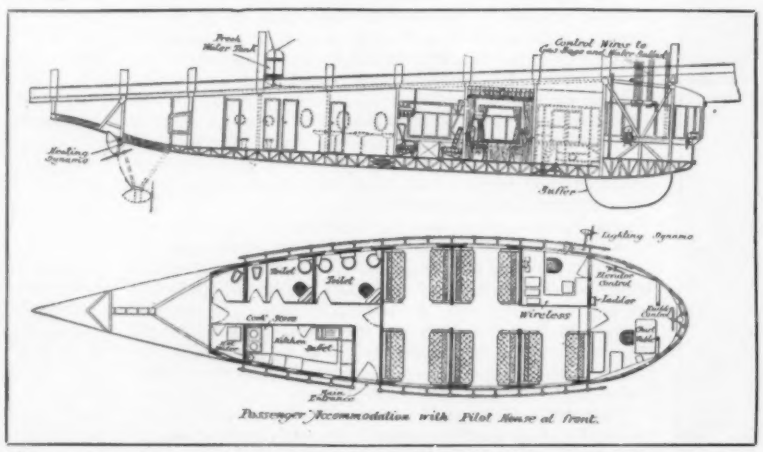
The framework of the new ship is similar to that of the "Shenandoah" as described and illustrated in our February issue, and the material of construction is an aluminum alloy somewhat similar to the duralumin of which the "Shenandoah" is built. The polygonal frames have 24 sides, and the whole skeleton consists of alternate main frames with intermediate subordinate frames. The main frames are braced with wire cables and they are tied together with the usual longitudinal girders. The outside covering of the hull consists of a cotton fabric, whose thickness varies according to the stresses at the particular part of the hull where it is employed, and it is "proofed" with several coatings so as to give it a smooth surface. The paint used contains a certain amount of aluminum powder, which serves to give the hull the dull glistening effect that renders an airship, when aloft, such a truly beautiful object. The most striking novelty, at least to the Americans who have seen the military airships "R-34" and "Shenandoah," is the large passenger and navigator car which is attached to the underside of the hull some 90 feet from the extreme point of the bow.

Unlike the cars of the two airships above mentioned, which are supported some distance from the hull by struts and wire cables, the framing of this car is riveted or pinned directly to the framing of the ship and, therefore, may be considered as forming an integral part of the main structure. We present an enlarged plan and a longitudinal section of this car, which is about 75 feet in length by 17 feet in width



A comparison of the outlines of the "Shenandoah" (dotted lines) and "ZR-3" (full lines). "Shenandoah" measures 78¼ feet by 680 feet; "ZR-3" is 90 feet by 656 feet

at its largest diameter. It is strongly constructed of built-up aluminum girders similar to those used in the main hull, and these girders are rigidly attached to the main and secondary frames of the ship. Forward in the bow of the car is the Captain's cabin or navigating room, whose interior resembles somewhat that of the control car of the "Shenandoah," as shown in our February issue. Forward is the steering-wheel with the compass in front. The elevator control is to the left, and on the opposite side is a chart-table. Passing through a door in the after bulkhead of this compartment, one enters a central passageway which leads through the full length of the car. The first compartment on the right is the radio room, which is entered by a door connecting with the navigating room. Astern, on either side of the passageway, are the seating arrangements for passengers, which are generally similar to those found in a Pullman car. The seats are so arranged that they can be made up to provide upper and lower berths, and there are curtains which can be drawn to provide the necessary privacy for each compartment. Abaft this section, and shut off from it by a doorway, are several toilet rooms, while on the opposite side of the passage is a buffet, kitchen, etc. The car is heated by means of a propeller-driven dynamo, carried on a hinged strut, which is lowered when the heating of the car is necessary, and can be drawn up against the body of the car and out of the way of the airstream when heat is not required.



Plan and section of the car containing the pilot house and the passenger accommodation

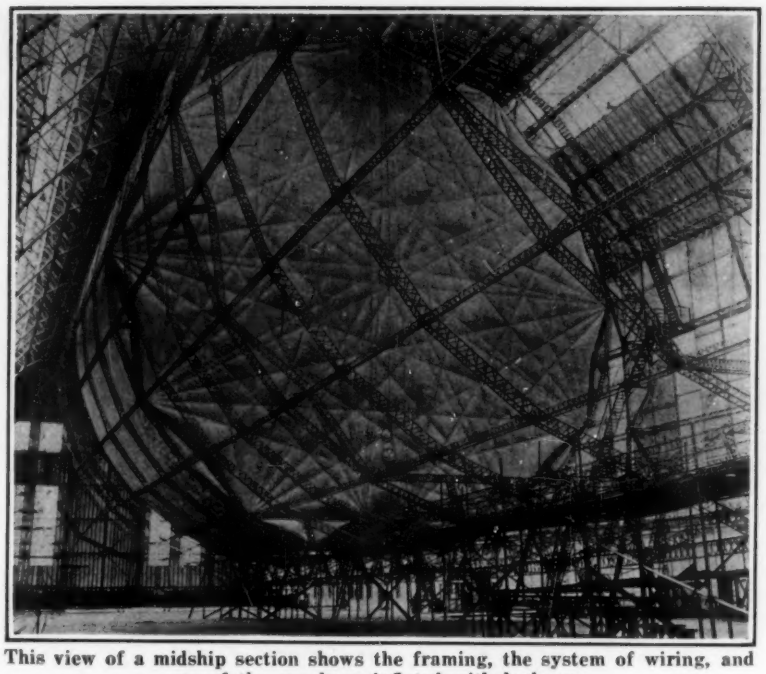
The motive power of the new ship is the largest ever installed in an airship, and it consists of five 12-cylinder, Maybach engines specially designed for airship service. Each engine is carried in its own enclosed and streamlined car. Four of them are mounted on opposite sides of the keel, and the fifth is carried aft, immediately below the keel. Each motor develops 400 brake horsepower at 1400 revolutions per minute, giving a total of 2000 horsepower for the ship. The engines can be reversed, and the reversing and starting gears are both operated by compressed air. The Maybach motor achieved a great reputation during the war, and the experience thus gained has been incorporated in the present motors, which differ from the war motors chiefly in their ruggedness and strength. All motors are directly connected to the propeller. The notable difference from the war type is that, here, we have twelve cylinders arranged in V-form. Each cylinder has one inlet valve, two exhaust valves and two spark plugs. There are four Maybach carburetors carried between the two rows of cylinders. Boch magnetos are used, and the ignition works in either direction of rotation. The engines are started by compressed air, and it is claimed that a large starting movement is secured on a very small consumption of air.

The fuel tanks are divided into working and storage tanks, the former feeding by gravity. The storage tanks can carry a total of 17 tons of fuel. For the journey from Germany across the Atlantic to America, 30 additional tanks are being provided.

The accommodations for the officers and men include a cabin for the Commander, two sleeping cabins for the officers, an officers' saloon with dining accommodations, six sleeping cabins for the crew, two saloons for the crew, and two sets of lavatories. The whole of this accommodation is provided within the hull along the sides of the central corridor which runs the full length of the ship.

All of the cooking, both for passengers and crew, is done electrically, and it should be added that in addition to the accommodations for officers and crew contained within the ship, provision is also made for baggage, mails and cargo in 20 compartments arranged along the length of the central corridor. With the barometer at 760 mm., the air and gas temperature at 0 degrees Centigrade, the air at a humidity of 60 degrees, and the vessel charged with two and one-half million cubic feet of hydrogen, having a specific gravity relative to air of 0.1, the weight and carrying capacity of the new airship, as given by the builders, will be as follows:

Lifting effort, 89.6 tons; gross weight, 45.5 tons; useful lift, 44.1 tons; speed at full power, 75.8 miles per hour; normal speed, 5 engines, 67 miles per hour; speed, 4 engines, 62 miles per hour; speed, 3 engines, 56 miles per hour; radius of action, 5 engines full power for 46 hours, 3480 miles; radius of action at cruising speed for 78 hours, 5121 miles.



This view of a midship section shows the framing, the system of wiring, and one of the gas bags inflated with hydrogen

The Food of Corals

ACCORDING to Dr. T. W. Vaughan of the U. S. Geological Survey, the builders of coral reefs and islands are entirely meat-eating animals. In experiments conducted by him in the Tortugas, in the Gulf of Mexico, corals persistently refused a vegetable diet, but even water fleas were not swift enough to dodge the tentacles of these carnivorous creatures.

The living coral is a branched colony of individuals all connected together and having their soft bodies encased in strong cells. Each individual is little more than a stomach, with a mouth surrounded by tentacles and sheltered in a little cup of the limy skeleton within which the whole colony is enclosed.

Dr. Vaughan describes how, when a little beef juice or a small bit of meat, usually crab flesh or fish, was offered, the tentacles at the outer edge of the colony would begin to appear. Then the stimulus was transmitted to other members of the colony until the surface of the specimen had opened out like a beautiful flower. This condition seems to indicate that the coral colony is hungry and ready to capture food.

Corals have special mechanisms for catching food, including tentacles containing stinging cells and cilia, or hair-like extensions of the outer layer of the soft tissue which in response to certain stimuli beat toward the mouth opening, and in response to others beat away from it. The outer surface also secretes mucus in which particles of food may be embedded and this mucus is moved by the beat of the cilia either toward or away from the mouth.

Many different kinds of food were offered the corals, but they took only animal food. A piece of diatom meat was placed on one side of the oral disk, between the tentacles and the mouth, and a piece of crab meat on the other. Invariably the crab meat was seized and swallowed, while the diatoms induced no reaction except ultimately to be removed from the surface. No kind of purely vegetable food was taken by any one of the numerous species investigated.

When hunger is entirely satisfied, the tentacles retract and the ciliary motion reverses and particles of food are moved away toward the outside edge of the colony.

At the rate of upward growth observed in the reefs of the West Indies it would take from 6531 to 7620 years for the formation of a reef 150 feet thick in one of the species examined, while another could build the same thickness of reef in 1800 years, while some of the Pacific forms grow still more rapidly and might accomplish as much in 1000 years.

Filter-Passers: Living Beings Smaller Than Bacteria

IT seemed to the pioneers who first sighted the bacteria—those minute fungi, distant cousins of the breakfast mushroom—that they had attained their goal, and that Life could not live in narrower confines. Yet today we hear of living creatures far smaller than most bacteria, but of even greater importance in the havoc they work to the human race. To this group of living morsels has been given the name of "Filter-passers," and, although they have baffled research from the time of Pasteur to the present, it would seem that now at least we are beginning to understand more about them.

Among the diseases believed to be caused by them are first, and most important in its universality, influenza; but small-pox, hydrophobia, scarlet fever, and measles are also attributed to the same group of organisms, as are foot and mouth disease in the animal world, and distemper in dogs. Even the plant world suffers from them, for mosaic disease in tobacco plants is due to them. All these diseases are very infectious—infinitely more so, for example, than the bacterial disease, typhoid fever, which can only be contracted by eating infected material or injecting bacteria.

The size of a filter-passer is emphasized by the property from which it has derived its name—the power of passing through a filter. The filters used by the careful housewife to purify her water supply, and by the bacteriologist to rid the fluids, with which he works, of bacteria, are of two kinds. The Berkefeld filter is made by compressing an earth which consists of the flinty skeleton of a microscopic plant known as a diatom—an earth which is also used as a tooth powder. It has been estimated that particles as large as a five-thousandth part of a millimeter can pass through this filter in some instances. The second kind of filter, the Chamberland, is made of unglazed porcelain, and has much smaller pores. Any particle which passed through it must be smaller than a twenty-thousandth part of a millimeter.

Every filter-passer can pass through a Berkefeld filter, some can negotiate a Chamberland, and one has been described—the organism responsible for mosaic disease in tobacco plants—which is even said to be able to diffuse through gelatine.

Filter-passers, however, are not too small to be seen. The trouble is that when a fluid, such as a nasal secretion from a dog with distemper, is looked at by these special means, so much is visible that it is not possible to distinguish the filter-passer from other unimportant particles.

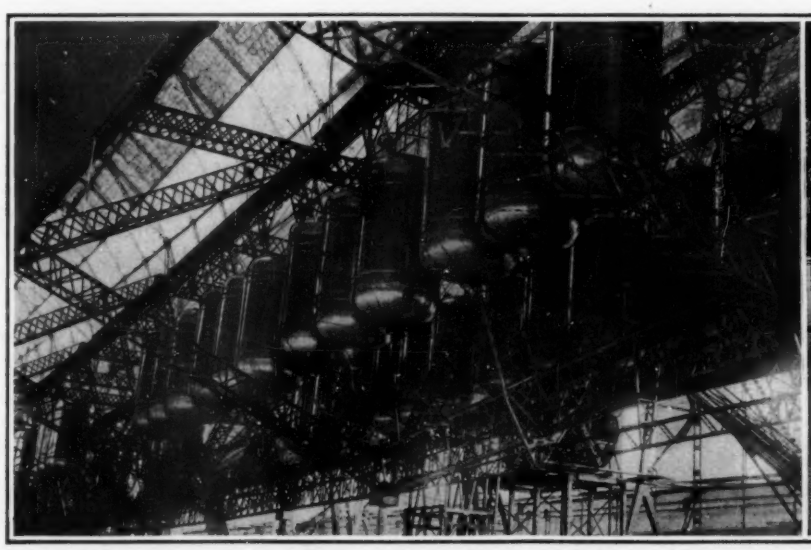
Even a bacterium is not easy to identify if examined in a state of nature. It must first be "stained" with aniline dyes; and the aniline dyes themselves consist of relatively large particles. Staining filter-passers has therefore not proved helpful—the particles of dye and the organisms themselves are too nearly of the same size.

On the other hand, in distemper, influenza, and rabies, to mention only a few diseases, the objects seen do not resemble bacteria. They are tiny specks—that is all that can be said of them.

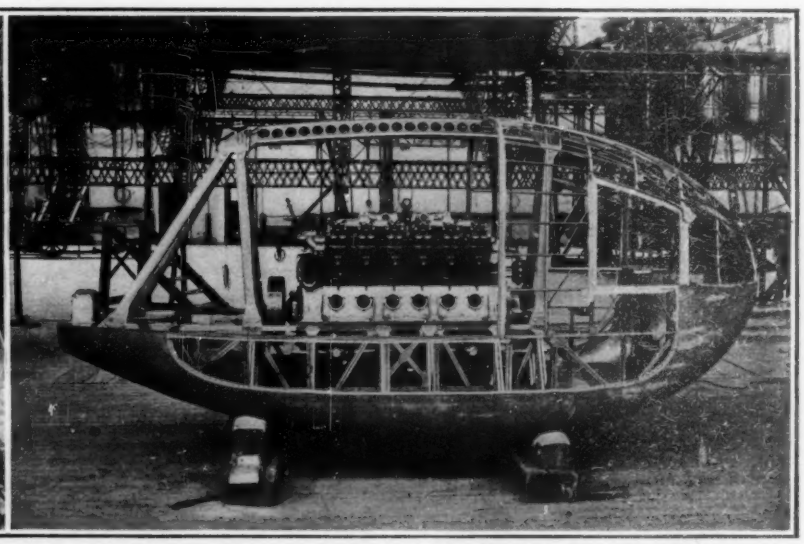
How, then, do we know that these little objects are alive? And if alive, how can we be sure that they cause the disease?

Life is always difficult of definition. The answer is that one very significant property of living matter is its power of reproduction, and that on the establishment of that feature in filter-passers the whole theory of their nature rests.

If we can grow the filter-passer, take a tiny morsel of the growth, and grow it again and again on suitable soil, we prove that it is reproducing itself and is alive. Volpino, an Italian scientist, has grown the filter-passer which causes cow-pox. Noguchi, a Japanese bacteriologist, was the first to grow a filter-passer, in 1913—the organism of infantile paralysis.



The ship can carry 17 tons of fuel. Here we see a dozen of the tanks suspended within the keel structure. Thirty extra tanks are provided for the ocean trip



One of the five engine cars. Each carries a 12-cylinder, Maybach engine of 400 horsepower. Maximum speed, 75 miles per hour

Our Abrams Investigation—VII

Queer Adventures and Queer People Met in Our Quest of the E. R. A. Truth

By Austin C. Lescarboura

Secretary of the SCIENTIFIC AMERICAN Abrams Investigation Committee

VISUALIZE, if you will, a darkened room; a boy, naked from the waist up, standing in the center of the room on a pair of metallic plates, and wearing about his head a rather impressive strap which carries an electrode; a collection of crude electrical apparatus on a nearby table with a maze of wires; a grave diagnostician, sitting in front of the boy and stroking the latter's bare abdomen with a glass rod. A small piece of blotting paper, containing a tiny blot of blood, has been placed in a receptacle known as the dynamizer, and a horseshoe magnet has been brandished over the various parts of the apparatus and over the headgear of the youth. The switches on the apparatus have been set to a certain point, as accurately as their flimsy construction permits.

Presently, the rod seems to stick or grow heavy over one portion of the youth's abdomen. The diagnostician glances at the setting of the switches, and calls out to the assistant, standing with pad and pencil: "Diminished resistance, 18 ohms." The crude switches are adjusted again. More stroking of the abdomen. "V. R. 55, plus 6," which, translated into your language and mine, means the so-called vibratory rate of 55, representing acquired syphilis, 6 ohms. A new setting of the switches. More stroking. "V. R. 42, 3 ohms," which, translated, means vibratory rate 42, or tuberculosis, 3 ohms. And so it goes. Lest we make any mistake about it, let us be reminded that these diagnoses apply, not to the young man who submits to the caresses of the glass rod, but to the person from whom the blood in the dynamizer was taken.

Were it not for such high-sounding terms as vibratory rate and ohms, we might take this entire scene to represent the medieval alchemist at work. Or again, it might go well as a ritual of some savage tribe, intended to drive away evil spirits. Certainly, it does not fit in with the present age—the age of the electric light, radio, X-ray, phonograph, steam engine, wonderful machinery.

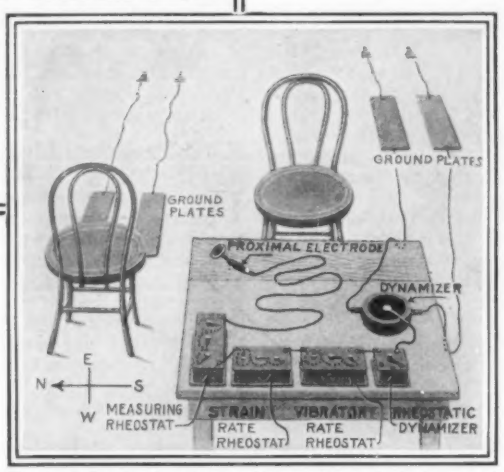
Yet here is a diagnosing technique which has been gaining ground. Here is a method of learning what is wrong with suffering humanity, which has been gaining popularity during the past few years, ever since one Albert Abrams, a well-known doctor of San Francisco, announced to the world his discovery of the radio-activity of human blood and a new method of diagnosing and combatting disease. Here is a method that has been espoused by numerous doctors and near-doctors who have abandoned their *materia medica*, in which they had such faith in by-gone days.

From one end of this big country of ours to the other we have these abdomen-strokers at work. Most of them are working in the open, quite proud of their mastery of the new technique. They call themselves E. R. A. practitioners—Electronic Reactions of Abrams practitioners, when given in full. Then, more startling still, we have many physicians engaged in this abdomen-stroking in the obscure corners of their offices and homes, far removed from the prying eyes of the world at large. These are the men who hesitate to connect their names with the E. R. A. movement, yet have come to believe that, after all, in the deepest intricacies and all-but-hopeless inconsistencies of this entire mess, there may be something fundamentally true and highly important. Many a dignified doctor has an Abrams outfit concealed somewhere about his establishment, which engages his spare moments and gives his already tired mind plenty to think about. Again, there are men of wealth and with adventurous minds, hard at work with the E. R. A. apparatus, endeavoring to find out what this crude stuff really does and how it does it. They are spending tens of thousands of dollars in this work, hoping, perhaps against hope, that here we may have the whole secret of that intricate thing which we call health. Then, too, we have electrical engineers and physicists, men whom we have come to look upon as cold, calculating mentalities, dabbling with the E. R. A. technique—dabbling, we say, because they cast aside all their cold, calculating ways when they work in E. R. A. methods, and accept the most obvious piffle which even the untrained layman would refuse to take seriously.

The adventures of Alice in Wonderland are tame in comparison with those of an investigator in the land of E. R. A. We are prepared to make due allowances for the fiction of the former, but when it comes to the latter, we are dealing with the cold realities of 1924 A.D.

What does it all mean? In brief, we are told that Dr. Albert Abrams, recently deceased, discovered that human blood, even so little as a drop of blood, gives off radio-active emanations or waves of some sort, and that these emanations or waves can be tuned in by means of crude rheostats and detected by the sensitive nerves of the human body. A perfect or near-perfect specimen of humanity serves as the detector or "reagent," as he or she is called in E. R. A. parlance. Various settings of the rheostat switches represent various disease values, and thus we can determine whether the blood specimen gives off tuberculosis or carcinoma, malaria or sarcoma, cryptogenic syphilis or diminished resistance only, and so on. And, what is more, we can also determine the quantity of each disease in the drop of blood, although all the while the patient whose blood is being tested may be thousands of miles away. The late Albert Abrams went even further than the mere testing for diseases; his clinical reports told of how he could determine the religion and racial strains of the blood, and detect such matters as a will to deceive, an incipient love affair, and other deeply-rooted human emotions. At a pinch, the blood specimen could be done away with, and in its place a specimen of handwriting could be used in diagnosing the case by proxy, as it were.

OUR Abrams investigation, though we are still unable to find any electronic practitioner who will undertake any sort of a set test, proceeds apace. We are now making systematic tests with independent physicians who, as a matter of possible scientific interest and without in any way committing themselves, have mastered the electronic technique. Reports of these tests will appear in an early issue. In the meantime, as the seventh installment of the series which started last October, we describe here some very damaging performances given in our presence and out of it by electronic practitioners who were rash enough to attempt the, apparently, less incriminating "demonstration" of their technique.—THE EDITOR.



Typical E. R. A. diagnostic equipment set up and ready for use. The reagent stands on the left ground plates, facing due west, with the proximal electrode on the forehead

All of which hinges on one fundamental claim. When the electronic energy or whatever it may be flows from the blood specimen or handwriting specimen through the rheostats and to the human detector, it is said to cause changes in certain areas of the abdomen, in which case the reactions, as they are called, make known their presence by a dulling of the percussive note. Again, if a glass or hard rubber rod is rubbed over the proper areas, it will stick or become heavier when the reactions take place, so it is claimed. Still again, the reactions may give rise to a certain roughness of the skin, which can be detected by the sensitive finger tips of the skilled E. R. A. diagnostician, so it is said. Finally, we are assured, the reactions may cause the proper areas to blanche or whiten, so as to form a marked patch quite distinct from the pinkish appearance of the rest of the abdomen.

It is on these reactions in the reagent or human detector that this entire E. R. A. technique rests. Time and again Dr. Abrams and others have endeavored to work out electrical or mechanical substitutes for the human detector, but nothing so far has been found as hyper-sensitive as the human nerves. So, no matter how elaborate may be the diagnostic equipment; no matter how impressive may be the charts and curves presented by many so-called electronic investigators, the foundation is always the mysterious reactions in the human reagent or detector.

For six long months the Scientific American Abrams Investigation Committee has been seeking objective proof of these reactions, fully realizing that here was the true starting point of the entire matter. Early in our investigation we came face to face with the percussive method of eliciting reactions, but were not deeply impressed because of the ease with which the effect of dullness could be produced, intentionally or quite unintentionally. The sticking of the glass rod or hard rubber rod next came to our attention. This seemed more substantial. And, what is more, this seemed to be a method which we might try ourselves, and thus become convinced of the existence of the reactions. Then came the sense of touch method, which we could also try, even though we were assured that one had to be skilled in this technique to feel the difference in the texture of the skin. On several occasions attempts have been made to show us the blanching of the skin.

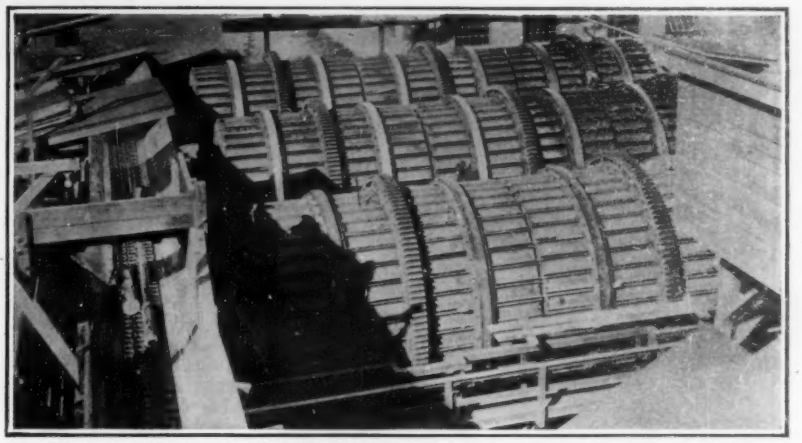
The sum total of all these efforts on the part of earnest E. R. A. and other electronic workers, as well as ourselves, is, so far, a total failure. We have been given absolutely no proof of the occurrence of these reactions. Once, while working with other investigators like ourselves, and serving in the capacity of reagent, we had the distinct impression that we felt the reactions. Indeed, the writer immediately notified several leading E. R. A. men to that effect. Upton Sinclair, in his latest article, mentions that fact, which only goes to prove once more that this investigation, first, last, and always, is sincerely intended to get at the truth. However, subsequent experiments and tests with the same men, as well as stroking our abdomen with a plain stick in the quiet of our home, without extraneous influences of any kind to produce reactions, caused us to decide that the reactions originally felt were merely the reflex action of the sensitive solar plexus when subjected to the heavy pressure of the rod. We use the term "heavy" advisedly. No gentle tickling is the treatment to which the electronic reagent submits, but a decidedly vigorous massage. A colleague possesses sensitivity of the abdominal nerves so extreme as to amount to a family joke; and he found the attempt to act as reagent so punishing that he was forced to abandon it in short order. It does not seem possible that such vigorous application of an external stimulus can be without its reactions, apart from anything electronic or otherwise mysterious.

Do these reactions really take place? Or are they nothing more than a bald fake? Both those questions have received our careful thought, and our observations have been directed toward answering them. At present we are prepared to state tentatively, always reserving final judgment in the event that we are given proof which would cause an immediate change of opinion, that the reactions are not objectively real; that is to say, they cannot be detected in any way by any person other than an E. R. A. diagnostician or one with strong E. R. A. convictions. They cannot be demonstrated to a person of an open frame of mind, just as certain psychic phenomena fail to impress the average person. Even the great Abrams insisted that the will to believe was a prerequisite in this work. Very significant, that!

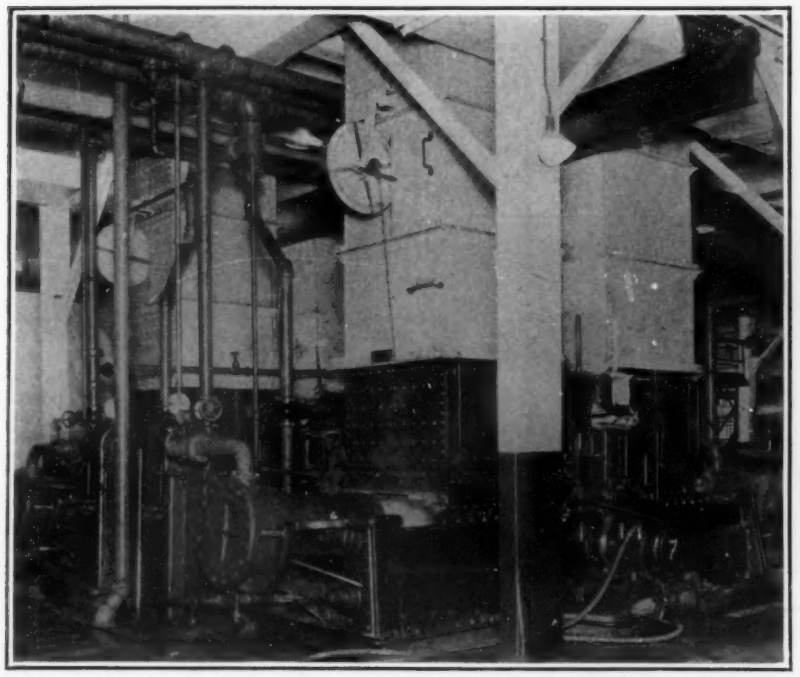
Yet we are led to believe that the reactions are not a bald fake. They could be readily faked, true; but there is sufficient evidence that the usual E. R. A. diagnostician firmly believes he is getting the reactions. Whether he is percussing, stroking, feeling or seeing,

(*Continued on page 278*)

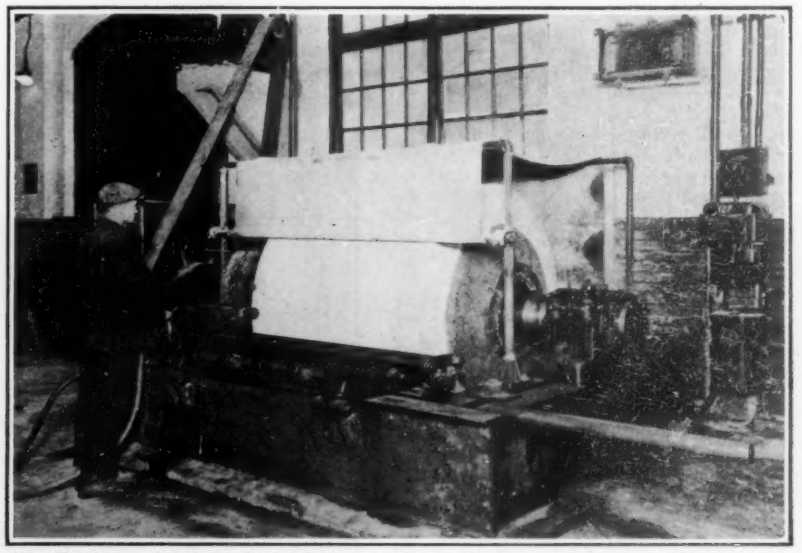
(1) In summer all the wood necessary for current consumption as well as for the coming winter is floated down the river or brought in cars from the forests. The logs float down the rivers and each mill takes out its own logs by impounding all the logs and then letting those of other mills pass out through so-called "sorting gaps." The logs are 12, 14 or 16 feet in length. These logs are taken as required and cut into four-foot lengths by means of saws in what is called the "slasher mill." The "sticks" are either used immediately, or are led to the "stacker" which piles them in the huge storage pile, such as this one containing 60,000 cords



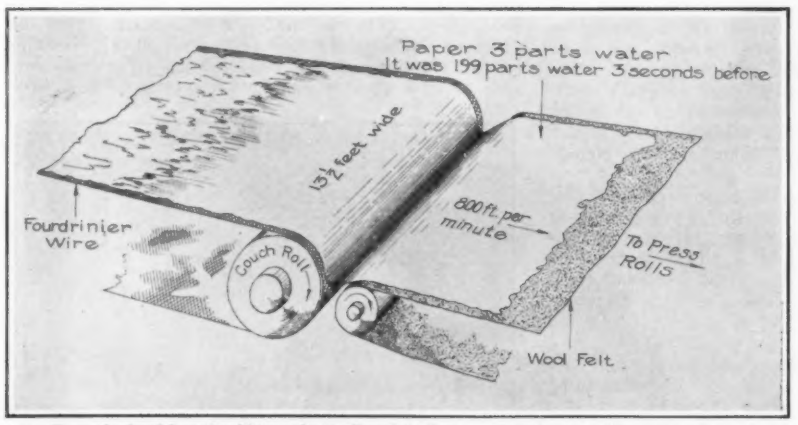
(2) The logs still having their bark are led to the "barking mill," as shown in this view, here to have the bark removed. This process involves the use of three drums made in sections that are bolted together. Each drum is 46 feet long and 12 feet in diameter. The drums revolve at the slow speed of seven revolutions per minute and each drum requires 150 horsepower to drive it. The logs, introduced at one end of the drum, are tumbled about to wear off the bark, and then ejected clean from the other end, to be carried to the wood pile or to the "chip mill" or the "ground wood mill" for current use



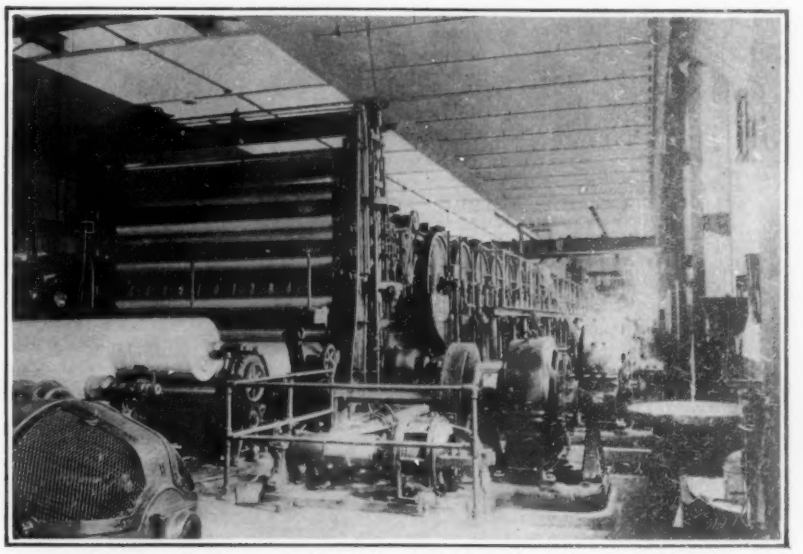
(3) Ground wood is produced by forcing the wood against grindstones each weighing 10,000 pounds. The small logs are fed into a reservoir in an upper story of the mill and are forced against the grindstone rotating at 240 revolutions per minute. Water is freely used, not only to remove the ground pulp-wood, but to prevent burning and over-heating the grindstone so that it will not burst. A hydraulic cylinder forces the logs against the grindstone. After the wood is ground it is known as "ground wood" or "wood pulp." It is then ready to be mixed with the sulfite pulp to form the mixture from which paper is made



(4) About every three hours the grindstones must be resurfaced, so that they will not become glazed and thus lose their grinding efficiency. There are two kinds of woodpulp which enter into the manufacture of newsprint. One is "mechanical" pulp, made by grinding wood into pulp against revolving stones as already shown. The other is "chemical" pulp, made by cooking the wood chips in dilute acid baths under pressure. The chemical pulp, known as sulfite, is the one used in combination with ground wood in the manufacture of newsprint. A pulp mixture of about 1 per cent pulp and 99 per cent water is now prepared and delivered into the head box placed at the head of and across the full width of the paper machine



(5) From the head box the dilute pulp is allowed to flow evenly onto an endless wire belt, made of fine copper or bronze wire meshed from 60 to 70 to the inch. The endless screen of wire moves forward with a lateral oscillating movement down a slightly inclined plane, at a speed as high as 1000 feet per minute. The movements spread the pulp evenly for more uniform matting or "felting" of the fine fibers as the water drains away through the wire, leaving a deposit of interlaced and commingled fibers in the form of a wet sheet. Suction boxes along the path of travel suck out still more water. Finally the pulp sheet leaves the wire screen to pass between two rolls, called the "couch rolls," as shown here. The upper roll (not shown) is covered with felt and gently squeezes more moisture out of the sheet against the lower roll. At the conclusion of this process the watery pulp has been changed into paper



(6) And here we reach the paper machine, through which the damp sheet now runs on a woolen belt from the wire screen on through a series of "press rolls" which remove much of the remaining moisture. At this stage the sheet of paper still contains from 65 to 70 per cent of water. The sheet now passes over a long series of heated iron cylinders which dry the sheet. It then passes over a vertical stack of smoothly finished steel rolls of smaller diameter, called "calenders," which virtually iron the sheet smooth. This machine, in the plant of the International Paper Company at Three Rivers, Province of Quebec, measures 277 feet long and makes 950 feet of paper measuring 152 inches wide in one minute. The paper is too wide for the requirements of commerce, hence it is reeled at full speed and is afterward taken by the "winder" to be cut and wound into hard rolls which are wrapped and shipped to the hungry presses of the publishing world

FROM LOG TO PAPER: A BRIEF VISIT TO A GREAT NEWSPRINT MILL IN CANADA

Saving Dollars by Salving Scrap

How the Multitudinous Wastes of a Great Railroad Are Converted Into Cash Values

By Charles W. Geiger

The rail straightener in the Southern Pacific reclamation plant

MODERN railroad efficiency methods are well exemplified in the way the Southern Pacific Railroad Company avoids waste in the use of materials by the utilization of what was once discarded as worn out and useless. Many parts that might have acquired a new lease on life through very little attention were formerly relegated to the scrap pile. Wastefulness was accepted as a matter of course and it took a keen sense of personal responsibility to overcome the deep-rooted habit. The actual custodians of the company's property are the employes and whatever benefits one, also benefits the other. A conscientious employe exercises care in removing and replacing parts to avoid breakage, does not abuse the tools or machines on which he is working and endeavors to get maximum service out of every article the company furnishes. In other words he cooperates.

Much of the material collected by the supply trains, is not scrap at all, but merely slightly worn or deformed, so as to be unserviceable. Specialization in this work has created and built up an important department, the sole object of which is reclamation. The Southern Pacific Company (Pacific system) during 1921 would have had to draw $872,000 from its treasury to purchase new the volume of material reclaimed in that year. The company saved $735,509.05 on its Pacific System during 1922 through the accumulation and reclamation of worn and discarded material.

As reclamation was an entirely new field, it was necessary to construct special machines adapted to the work to be done. For this purpose scrap parts were used and the apparatus entirely home made. A bolt straightener, for example, was made out of an oil wheel boring mill that had been broken and scrapped. The crooked bolts or bent rods are inserted between the V-shaped jaws, which alternately open and close. They are adjustable to take any diameter material from ½ inch to 1¼ inches. Material is fed into the jaws a few inches at a time and rotated, appearing on the opposite side, straight. The bolts are cut to length in a home-made alligator shear, and rethreaded.

A nut remover of novel construction is being used. The shank of the bolt is gripped in the vise jaws, while the nut is forced into the bell-mouthed chuck, which rotates in a left hand direction. As soon as the nut is free of the bolt, it drops out of the chuck. One chuck will handle three different sizes of nuts.

Pipe fittings, track bolts, nuts, etc., pass through a "rattler." The revolving drum is one-third submerged in distillate, which in the course of twenty minutes thoroughly removes dirt and scale. The drum is then lifted by a small crane and the contents dumped onto a sorting table, which is inclined so that the distillate drains back into the tank. While one charge is being rattled, the preceding one is being sorted into trays according to size and kind. Gages are provided but experienced operators rarely need to use them. Nuts are retapped on a six-pointed tapping machine; washers and other small parts are ready for use without further attention. The distillate not only cleans and brightens the parts but acts as a preservative against further rusting.

Rattler for cleaning fittings against possible re-use

Track spikes are handled through an oil furnace by gravity, being dumped into a hopper and fed through the furnace as rapidly as they are extracted from the bottom. While hot the spikes are dropped into the home-made straightening press. If the heads are out of alinement they are given a light blow with a hammer. The press is double-acting so that the instant the finished spike is released the center block starts compressing the spike just dropped into place on the opposite side, thereby saving air and increasing production. This machine straightens 2000 spikes in an eight-hour day.

A grinder for refacing the steam joint of Klinger water glasses, consists of an abrasive disc which slowly rotates, the outside edge of the disc being slightly eccentric. Six glasses are mounted with bevel side downwards, in the small holding clips which are weighted by the hinged load on the back of each. The eccentric, above referred to, actuates rollers, which transmit motion to the glasses, causing a swaying movement of fifteen degrees, thereby eliminating wearing grooves or ridges. No abrasive is used other than the glass itself, and water. The output of this machine is eight glasses per hour and the machine once in motion requires no further attention.

A machine has been devised to strip scrapped dry cells. The zinc and brass removed are sold for scrap and the wax is made into sealing wax. While the saving in this instance is not large it more than pays for labor and other costs, and keeps the right of way clean of such rubbish.

Superheater units are reclaimed by renewing the return bend or applying new ball joints. The bends are formed out of scrap and are welded on to the extremity of the unit, making one continuous pipe. The ball joints are turned out of bar stock. A projecting lip engages the end of the unit pipe, holding the work central during the autogenous welding process. The unit joint is finally polished with a carborundum cloth, held in a cup-shaped chuck, attached to an air motor. Gages are used on all points and seats to insure proper contour. When finished the unit is tested to 250 pounds hydraulic pressure.

The foremen and employes in charge of this vast field of reclamation are continually striving for new and better methods of handling this work, and of adding to the great savings which have already been accomplished. They have a well merited pride and satisfaction of accomplishment which comes to all those who are making "two blades of grass grow where one grew before."

In many instances material discarded by one department of service is used by another department by means of which large savings are affected.

Scrap carpet is used for making covers for foot rests, dust guards, and hand protection pads for employes in rolling mills, foundries and scrap docks.

Scrap rope is unwound and used for binding company shipments in place of twine.

Sediment from acetylene generators is used in place of lime for whitewashing purposes, and in place of lime in the steel foundry.

Tarlene, a by-product of Pintsch gas plants, is used for painting underframes of cars, displacing the high priced paints which were formerly used for this purpose.

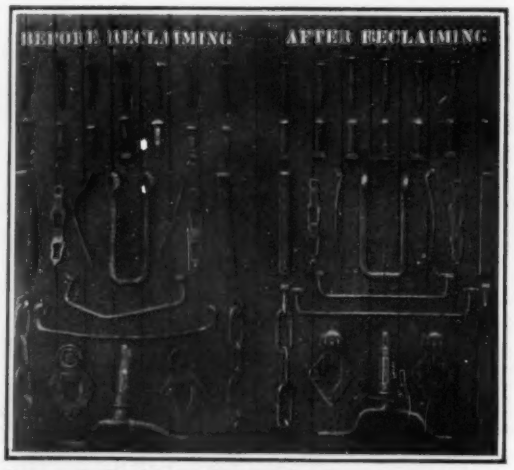
Scrap car roofing is made into tinware, smoke jacks, ventilators, shop lockers, etc.

Scrap boiler tubes are used for a number of purposes. When threaded or butt welded together they are used for water drain lines (after dipped in hot asphaltum), for air lines, conduits, etc., for manufacturing of locomotive pilots, in making freight car ladders, and in making washers by flattening out and punching, two washers being made by one operation.

Ball Lightning

IN a recent address before the Institution of Electrical Engineers (British) Dr. G. C. Simpson discussed the question of "ball" or globular lightning. Dr. Simpson came to the conclusion, which is now very generally held, that this is a real natural phenomenon. He summed up the characteristics of ball lightning as follows: the body or ball itself, which is able to retain its individuality as it moves through the air, appears to be composed of gas or matter in some novel luminous condition. The balls appear to exist independently of any large electrical intensity, for they have been observed within closed rooms where large electrical fields are impossible, and have also been observed to pass in and out of parallel telegraph wires. They appear to be associated directly or indirectly with large quantities of energy, for they have been observed to explode with violence, and have also been seen to fuse the overhead wire of an electrical tramway.

No satisfactory explanation of ball lightning has, however, been offered. Dr. Russell says: "Globular lightning seems to be a brush discharge taking place at the end of a column of air of higher conductivity than the neighboring air." He then points out some of the difficulties of this explanation, to which others can be added; in fact, there is really nothing very similar between a brush discharge and the ball of glowing gas so frequently described. The only physical phenomenon yet produced in a laboratory at all approaching ball lightning is the active nitrogen studied by Lord Rayleigh. In this case we have a mass of nitrogen subjected to an electrical discharge which continues to glow for some time after it has been removed from the field. Lord Rayleigh, however, is unable to accept this explanation of ball lightning, and all that we are able to say is that active nitrogen is the nearest physical phenomenon to ball lightning yet produced in our laboratories. Ball lightning appears always to be associated with a thunderstorm, and it is possible that the intense discharge of a lightning flash can produce some atomic change in the air or rain through which the discharge passes. If this is so, the glowing matter of ball lightning, which distinguishes it from others, may be in a state otherwise not met with in nature.



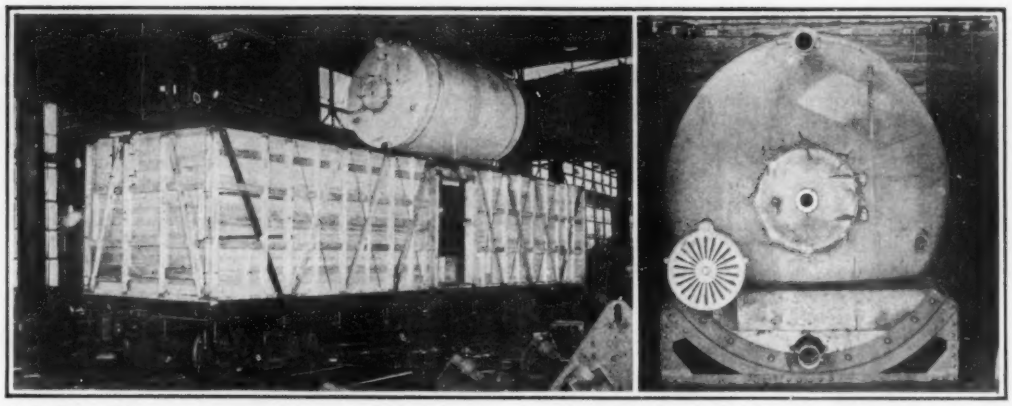
Some of the items that might have been junked, but weren't

Shipping Milk in Carload Lots

ORDINARILY milk reaches the railroad in tin-lined cans carrying from ten to fourteen gallons, and goes aboard the cars in these same cans. The inconveniences and dangers of this system are too obvious to require cataloging. But in the absence of specially constructed tank cars designed for the transport of milk and nothing else, the milk can is an unavoidable feature of the shipment of milk.

A Chicago manufacturer now offers a car for milk shipments which is really a thermos bottle on wheels. Externally, it is an ordinary box-car, forty feet long. Internally, it is two big tanks, end to end and occupying the entire length of the car, plus a brine refrigerating system. The floors are waterproof, and are carried sufficiently high up the sides and ends to prevent water from getting down and rotting the under sills. Drains are provided so that the car may be conveniently flushed. The refrigerating system is such as to insure a uniform temperature throughout the car. Each tank is equipped with recording thermometer, motor-driven propeller agitator, contents gage, and other fixtures; and the tanks are mounted in a three-inch bed of asphalt to control vibration. The capacity of the tanks is 3000 gallons, hence of the cars, 6000.

An interesting feature is that in a full shipment of 6000 gallons, there is a gain in milk delivery of 600 to 800 pounds. This represents the milk that adheres to the inside of the cans and has to be lost in the washing process; with the tank cars, the total adhesion is less than one quart. It need not be emphasized that the refrigeration is vastly more satisfactory. The tanks, by the way, are of enameled glass, which accounts for their low coefficient of adhesion.

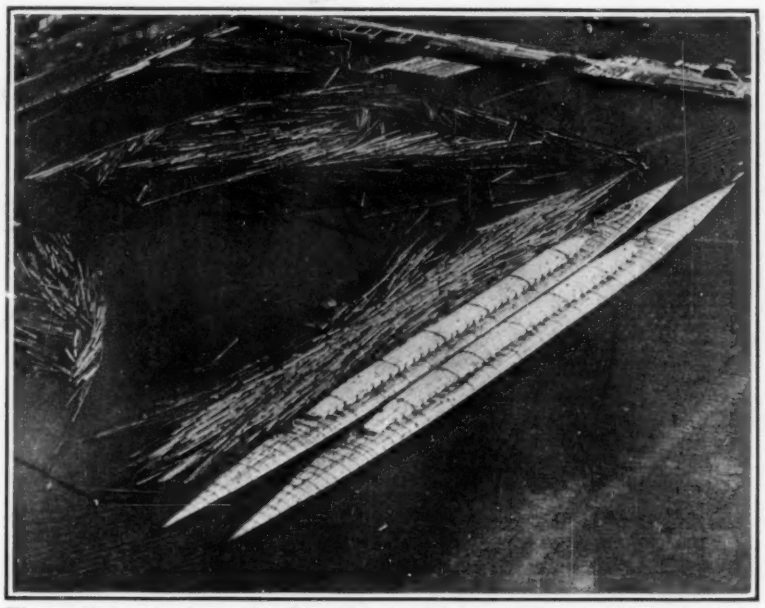


Left: The milk-tank car in construction, showing relative sizes of car and tank. *Right:* End view of tank in car, showing the controls that record and regulate the temperature and the condition of the milk

Glass enameled containers for railroad shipments of milk, which put this commodity on the same satisfactory shipping basis as oil

Log Rafts in the Open Ocean

LOG rafts are almost as old as logging itself; but it is not every day, or even every year, that rafting is indulged in upon such a scale as that shown in the accompanying photograph. These three huge log rafts, tied together structurally far more closely than is the case when only rivers are to be navigated, have completed a 1500-mile voyage in the open waters of the Pacific ocean, from British Columbia to San Diego. They are cigar-shaped, upward of 900 feet long, and contain millions of feet of lumber. Lashed together with ponderous chains, each raft was towed by a sea-going tug. The trip requires a month, and is attended with all sorts of dangers. It is not unusual for the tug to be obliged to cast its tow loose, returning to pick it up in a calmer sea. The utter impossibility of the raft's sinking makes it permissible to do this more freely than in towing of the more conventional sort. Our photograph, taken from the air by a pilot of the U. S. Naval Air Station at San Diego, shows two of the rafts side by side, with the third partially broken up. Somewhat better conception of the amount of timber in each raft may be got from the latter than from those which are still intact.



Three 900-foot lumber rafts that made the trip from British Columbia to San Diego, via the open ocean

The Danger to Alfalfa

PROMPT and aggressive action to save America's alfalfa and other crops from tremendous damage from the eel-worm disease is urged in an appeal issued by the United States Department of Agriculture through its well-known and ever-active Bureau of Plant Industry.

The eel-worm is an organism, scarcely a twentieth of an inch long when fully grown, that causes a disease which shortens the life of the crop by several years, makes frequent plowing and replanting necessary, and reduces the yield. Under favorable conditions, experiments indicate that the alfalfa eel-worm may injure red, white and alsike clovers, buckwheat, English peas, turnips and even potatoes, as well as alfalfa.

As many as 200 eggs may be laid by one eel-worm, the young being about a tenth the size of the adults. Under moist conditions these migrate or are carried by irrigation water or other means to new plants. They penetrate the tender parts of these plants and grow to maturity within the plant tissues, causing swellings and abnormal growths.

Finally the parasites become so numerous that they completely kill the plant. When this happens they leave it and go into the soil to attack other plants that they may be able to reach. A poor stand of dwarf plants is frequently the result.

The presence of the alfalfa eel-worm disease was first noted in America in 1921, when it was discovered in a single field in eastern Oregon. Since then it has been found more widely distributed in that general locality than was at first thought. It has been found in California and Colorado and it is considered possible that it may occur in other parts in the country. Efforts will be made by the Department of Agriculture to secure a complete survey of the entire country during the present growing season in order to discover all infestations and to eradicate the disease before it becomes too wide-spread and too generally established.

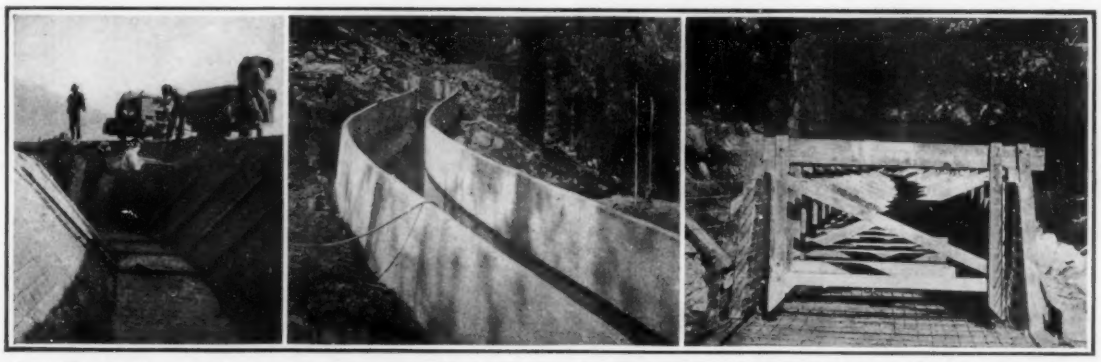
Building a Concrete Flume in Rough Country

A CONDUIT and flume line, 2½ miles long, was recently completed by the San Joaquin Light & Power Corporation on the north fork of the San Joaquin River in California, by means of which the water supply serving a chain of six power houses was materially increased. The inaccessibility of the upper end of the conduit line and the fact that a grade for a flume was cut along approximately the same location in 1910, made it advisable first to build a construction railroad along this old line, beginning at the lower end which was reached by road, and then to build the new conduit from the upper end down. With this plan a constantly advancing source of water supply was made available by admitting water from the upper end to completed sections of the conduit.

The original conduit built in 1910, to provide sluicing water for Crane Valley Dam, was a combination unlined ditch and wooden box flume with a capacity of 30 second-feet. The flume and trestles were largely destroyed by forest fire. The new conduit line consists of concrete lined ditch, concrete box flume, and riveted steel flume on redwood trestles, all with a uniform capacity of 100 square feet. Very careful figuring was required to make the new construction fit the old grade and at the same time to conform to uniform cross-sections as far as possible. It was not advisable to change the section more often than absolutely necessary, due to the additional cost and delays which such changes made in forms and reinforcing.

A construction headquarters was first established at the lower end of the line and a small warehouse and material yard were built there. An eighteen-inch-gage railroad with twelve-pound rails was then constructed. Most of the ties were salvaged from what was left of the old flume and the track was laid alongside the old ditch, on the upper side where possible. Where the line crossed ravines, trestles, to be used later by the steel flume, were built first and the railroad was carried across on them. The trestles were built as the railroad advanced so that except for a small amount of cement used in the trestle footing no material had to be carried in on the backs of workmen.

The accompanying views show just a few phases of this interesting work. As will be seen from these photographs, the forms are used repeatedly, effecting a heavy saving in material and transportation costs.



Left: The side-dump car for pouring the concrete shell of the flume. *Center:* A section of the completed flume. *Right:* Forms and reinforcing in place, ready for the pouring

Driving a concrete flume through the big woods with maximum economy

Little Fishes and Big Oil Pools

PETROLEUM is already one of the world's major sources of heat, light and power for production and transportation. It is also the source of supply for a thousand by-products that have come to be of immense importance to civilization, ranging from medicines through the field of dyes and chemicals to the asphalt residue which is used for road building and similar purposes. It is generally admitted that industry has not yet reached the limit of its uses, and each year the demand for its chief products—such as gasoline—is increasing far beyond the computations of a few years ago. In fact this increase brought about widespread apprehension that the supplies must be conserved; the fear that some day the world might exhaust its reservoirs of crude oil and that substitutes must be found.

In submitting his thesis that these fears are unfounded, Dr. John M. Macfarlane of the University of Pennsylvania is not advising against conservation. On the contrary, he is advocating it. But he would accomplish it by a more efficient use of the crude oil taken from the earth, by complete utilization of all the by-products, now in many instances permitted to go to waste. He points out that such a system has made it possible to produce oil from surface shale in Scotland on a commercial basis. The world's largest deposits of shale oil are in the western mountains of the United States, but heretofore there has been no exploitation of them except for stock-selling purposes. Yet the quantity of oil in such rocks is almost beyond computation, according to Dr. Macfarlane.

Perhaps the most startling feature of Dr. Macfarlane's claims is the assertion that since fish are the source of the world's oil supply, the reservoirs of the world are being constantly added to from that source. A very simple explanation is furnished of how that happens. It is merely a process of distillation by pressure. Virtually all known varieties of fish contain oil, and anybody can extract it by the pressure method. In the case of earth deposits of oil the extraction is hastened or aided by bacterial action in some instances. But the primary point is that this process is going on constantly, that it has been going on day and night, year after year, for millions of years.

Scores of questions naturally arise as to how anybody can know this, and Dr. Macfarlane has answered them all. But first he has shown that there is no difference between fish oil and rock oil when the conditions of its preparation are alike, or nearly alike. For that proof he obtained records of an experiment made nearly sixty years ago by two scientists at Harvard University. They had been concerned over the question whether earth oil was of organic or inorganic origin. Both were familiar with the fertilizer and oil industry built up on the menhaden, or mossbunker, one of the most populous fish known on the Atlantic seaboard.

Accordingly these two men made a study of oil shale, oil-bearing sands and similar strata, to obtain a general analysis of the chemical content of such materials. On the basis of that information they prepared a lime solution into which they mixed ordinary fish oil obtained from menhaden by the familiar commercial pressure method. When the mixture was made it was treated exactly as crude oil is treated for the extraction of gasoline and its other products—in other words, it was placed in a still and boiled. One after another the scientists succeeded in extracting exactly the same products as are obtained from crude oil or petroleum, until finally they had left a thick black residue resembling asphalt. The net result was proof that if petroleum was not fish oil, the two products were alike in that they yielded the same by-products.

For some strange reason that Dr. Macfarlane is unable to fathom this experiment was lost and forgotten for years. About twenty years later other scientists came across the record of it, and through their action it was preserved. But again for unknown reasons very little attention has been paid to it since. The discussion as to whether petroleum came from animal or plant life has gone on and on, and most of the participants have been wholly unaware of these experiments. In recent years, as part of the investigation made by Dr. Macfarlane, various repetitions of this experiment have yielded the same result.

With that fact firmly established Dr. Macfarlane set out to discover whether there have been enough fish in the history of the world to produce all the known oil deposits. There was no question that fish could have furnished the supply; it was simply one of quantity. And for that proof he turned again to the menhaden. This fish appears in the history of American industry since the days of the earliest settlements. It is so plentiful that it has been used as fertilizer and a source of fish oil all along the North Atlantic Coast. Many of these factories are still in operation, and millions of menhaden are caught every year to enrich the farms and to provide the oil of back-country districts.

Here again Dr. Macfarlane was able to get the aid of another scientist. He found that the late Dr. Brown Goode of Washington had made a prolonged study of the menhaden and its habits. As a result of that Dr. Goode estimated that in one season of from four to six months, when the menhaden are rushing north along the coast in countless millions, their natural enemies such as the bluefish consume at least a quintillion menhaden. He got at that figure by careful studies of how many mossbunkers are eaten by a single bluefish, and then estimating the number of the latter. Now an interesting point here is the fact that most scientists are inclined to believe that Dr. Goode underestimated this consumption. It may be of interest also to point out that a quintillion, expressed in figures, means a unit and eighteen ciphers, or 1,000,000,000,000,000,000 mossbunkers or menhaden.

The point of all this is that commercial oil-extracting plants get an average of one gallon of oil from 250 menhaden early in the season, when the fish are thin. Later in the season the quantity thus obtained is about doubled. On the basis of the first or lower yield, according to Dr. Macfarlane, it is only a matter of mathematics to show that this one variety of fish in a single season carry more oil than the entire world has used in the known history of petroleum wells. It might be added that the total consumption up to 1920 was estimated at close to nine billion barrels of forty-two gallons each. If the menhaden can continue to exist after the annual slaughter of a quintillion of their number, it is obvious that they must be virtually countless.

The assertion that fish are responsible for all the world's oil might still be open to objection without certain additional evidence. One natural question is "how did the oil get into the earth, when it is generally known that oil floats on water." For that also Dr. Macfarlane went to other scientists. The first evidence he obtained came from his predecessor as botanist at

(*Continued on page 294*)

How Gold Leaf Is Made

A SIGHT that never fails to draw a crowd is that of a sign painter lettering in gold. He paints the outline of the letters on the glass window or other surface and then fills in the lettering with gold leaf. This he takes from a book, made of many leaves of slightly reddish colored paper. It is very curious and engrossing to see him lift the leaf out of the book by means of a long camel's hair brush, the gold film adhering easily to the hair, seemingly as light as a feather and still as dense and substantial as a sheet of metal can be.

Gold leaf is familiar to all of us. Almost every window that we pass has some lettering on it done in gold leaf. But there are probably very few who know how gold leaf is made or who realize that the art is one of the oldest in existence today. For gold leaf was made by the ancient Egyptians in essentially the same manner as it is made at the present time. It is mentioned in the Bible and in fact most ancient peoples knew it and used it.

The first question that arises in the average person's mind when he sees lettering being done in gold leaf is, "Is this real gold?" Gold is precious and how can one afford to use it for so utilitarian a purpose? Gold leaf actually contains the precious metal. Furthermore, gold leaf is not so expensive as it appears; for a single sheet of the leaf contains so small a weight of the metal that it is really inconceivable how so fine a film can be obtained, possessing such minute weight.

There is no other solid known that can be made into a film of such infinitesimal thickness as gold. Gold is the most malleable of all substances, and gold leaf is the thinnest of all materials. The leaf, for all its commonness and antiquity, is really one of the most remarkable products made by man. It possesses a number of strange, contradictory properties which mark it out from all other substances. In the first place it will last for centuries, as the paintings and decorations on tombs and temples thousands of years old, testify. Gold is indestructible; it is unattacked by the elements, and after centuries of exposure it still remains the original yellow metal, so precious to man. On the other hand a sheet of gold leaf can be absolutely destroyed by merely rubbing it between the fingers. There is so little matter in the sheet of gold that the friction of the fingers is quite sufficient to make it disappear totally.

Gold leaf is perfectly opaque. When it is placed on a surface, it is impossible to see through it. But this same sheet of gold when held up to the light is very translucent. In fact it is easy to see through it and distinguish objects, all of course suffused in a greenish light.

Finally gold leaf is both visible and invisible. The sheet of gold, when held with its surface facing the vision, is perfectly visible. But when held sideways, so that edge of the sheet is being viewed, it is invisible. For the sheet of gold leaf is thin far beyond the range of human vision. It requires three hundred thousand sheets of the leaf, piled one right on top of the other, to make the thickness of an inch. The minute weight of the gold in an average sized sheet, three and three eights of an inch square, is seen from the fact that one ounce of gold, when made into a sheet of the same thickness, would cover 146.5 square feet. Five dollars worth of gold at present prices, made into a single sheet, would cover five thousand square inches.

There is absolute proof available to substantiate the contention that the art of making gold leaf was known four thousand years ago. Then as now, the gold was made into the form of a leaf by the might of the human arm. In other words it was beaten out by hammering it with an implement. The story runs that in very early times, when this art was being carried out under very crude conditions and a workman was beating a piece of gold with a smooth rock, he inadvertently covered the metal with his goatskin apron and beat the metal through the same. To his great surprise he found that the gold beat out into a much thinner and finer sheet. This marked the real start of the goldbeater's art.

Today the beating is carried out with a hammer, a cast iron hammer fastened to a wooden handle being used. The art consists in being able to distribute the blows over the surface of the beaten gold so that the extremely fine film is not torn. That there is a real technical skill involved is easily seen; it is hard to imagine how the blow of such a heavy hammer can be applied to the pack of gold leaf films, interleaved with goldbeater's skin, without smashing the whole mass of leaf into a fine powder. And yet a skilled beater will make but few holes in the gold leaft film.

The first stage in the process is to take 999-plus fine gold and mix it with a little copper or silver and make an alloy by melting in a crucible. The gold is then poured out into an iron mold one inch wide by six inches long by one eighth of an inch thick. The slab of gold obtained in this way, 23 karats fine, is squeezed between jeweler's rollers until a comparatively thin ribbon, one thousandth of an inch in thickness, is obtained. The ribbon is then cut into inch squares, each containing six grains of gold.

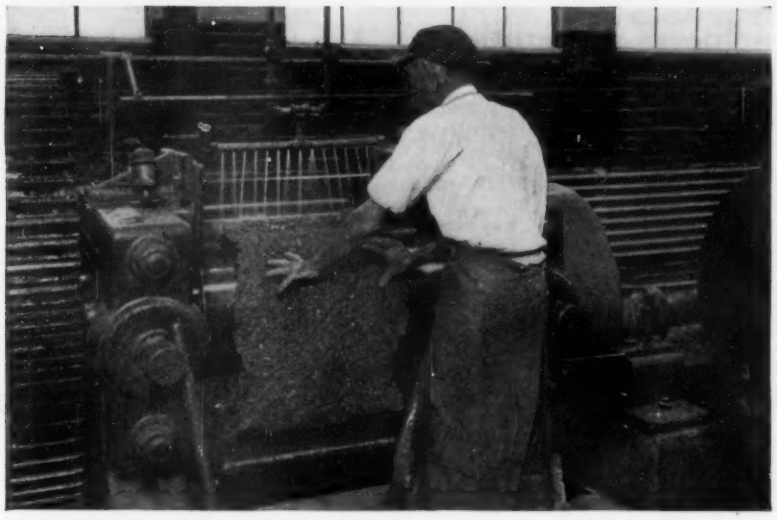
These squares are interleaved with pieces of parchment paper. Two hundred sheets of gold in the pack are hammered with an eighteen-pound hammer and the gold gradually spreads until the square is 3.75 inches on each side. This particular part of the process is very laborious for the hammer is rather heavy and its constant use tires the arm. It is the only part of the gold beating process in which mechanical beating machines have been able to replace hand labor.

Then each sheet of the beaten gold film is divided into four equal squares giving 800 sheets from the original inch-square gold ribbon. A pack is than made of 800 sheets, each sheet being separated from the next by a sheet of goldbeater's skin. This is a peculiar substance which is obtained by skinning the large intestine of the ox. The skin has a rough and smooth side and is very thin. Two of the skins are placed together, rough sides facing each other, and are stretched on a frame. The skins are made to join to give a single goldbeater's skin which is varnished with a special varnish, giving the finished product a golden-yellow color. The skins are then cut into proper size and are ready for use. The toughness of the goldbeater's skin is remarkable; it stands up extraordinarily well under the pounding with the heavy hammers.

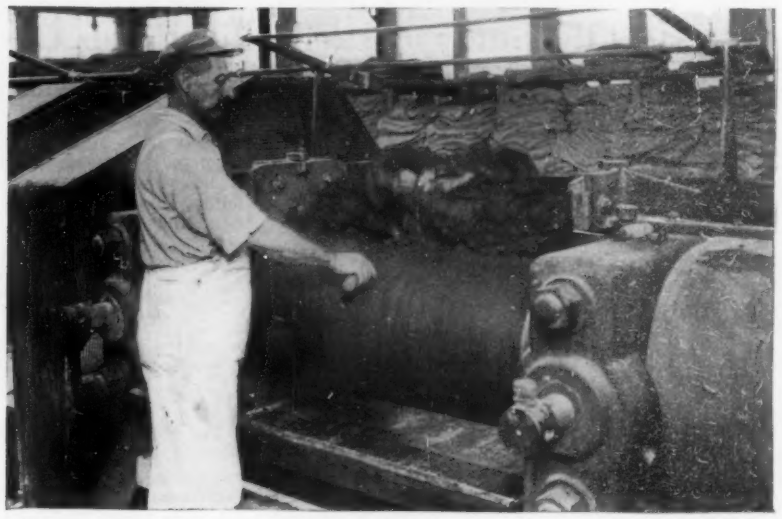
The pack of 800 sheets is now beaten with a twelve-pound hammer until the sheets of gold are 4.25 inches square. The beating operation lasts two hours and the beater pounds his hammer against the pack, distributing his blows to cover the entire surface evenly, starting at the center of the pack and working progressively outward while holding the same firmly between his thumb and fingers on the anvil.

The beaten films are again divided into four equal squares, giving a total of 3200 films of gold from the

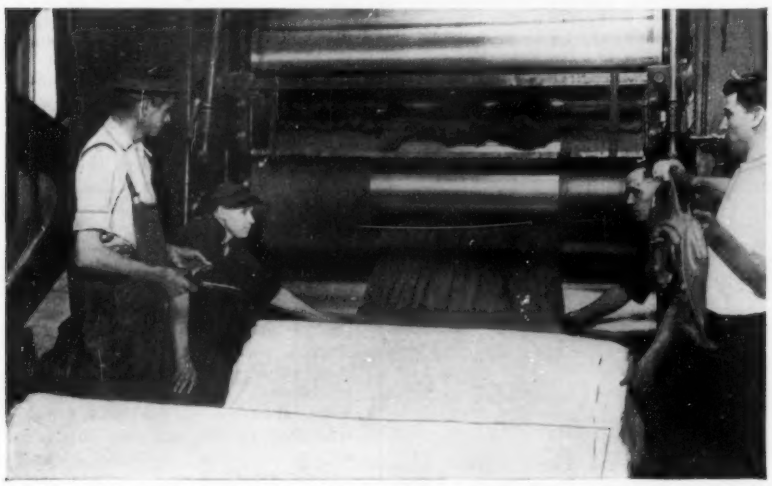
(*Continued on page 295*)



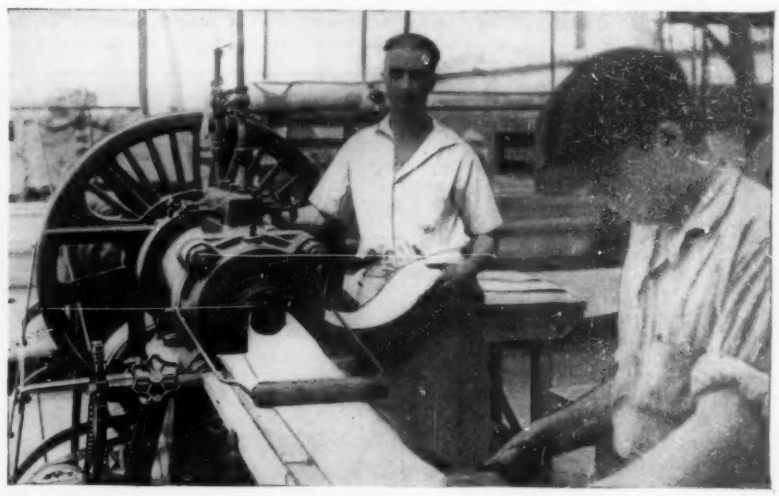
Of the three varieties of raw materials, those known as "smoked sheet" and "pale crepe" are comparatively clean, though they must be washed and dried before use. The third variety, "fine Para," which is less used today than formerly, has to have sticks, stones, and other foreign matter removed very carefully, as here shown, before it is used



Mixing mill into which the crude rubber and the chemicals are thrown, to be thoroughly crushed together between the rollers. Batteries of as many as thirty of these mills are used, and in the largest factories the rollers may be twice as long as these here shown. When the mixing is complete the mass resembles putty or soft dough

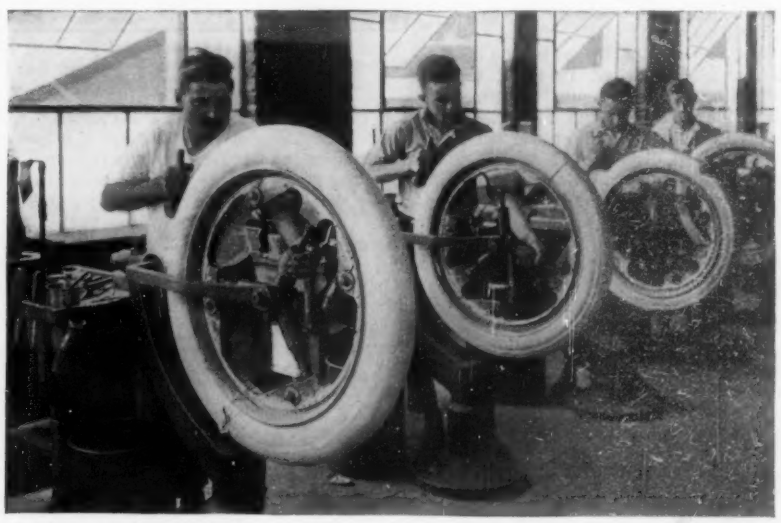


One of the big calender machines in which the fabric is impregnated with rubber gum, for the purpose of making the sheets stick together when built up into a tire. As suggested by the caption for the second picture above, the latest practice is inclined to favor a considerably wider fabric. The roll of cloth in the foreground is an apron that is wound up with the coated roll to keep its layers from sticking together



The hot-press tubing machine, one of two procedures that are used for forming the treads. The latter, which are much thicker in the center than at the edges, are in this machine pressed through a die the exact shape of the cross-section of the desired tread, and cut off at appropriate lengths. In the other, and more recently developed, process the treads are formed in a calendering machine of specially shaped rollers

After the vulcanized tire is taken from the case, the steel core is pulled out of the tire. Here the elbow-grease method illustrated is being largely supplanted by an automatic machine



Finishers at work smoothing down the joints of the outer trend, which is of pure rubber gum. As the picture indicates, no satisfactory machine for doing this has been devised

While the cord tire is radically different in its structure from its fabric predecessor, this difference is not such that an entirely different outfit of machinery is necessary, from start to finish, in its production. Many of the processes in the preparation of both types of shoe are similar, and accordingly many of the inprovements in machine design which really belong to the cord tire have reacted upon the fabric tire and have gone into use in its production. The effort in the above pictures has been to tell how the typical fabric tire was made in the hey-day of its career, rather than how fabric tires are today made with as much of the cord-tire technique as is applicable. In an early issue we shall present a similar series of photographs for the cord tire, which will show how these improved and more expensive shoes are made. The two stories together will be an epitome of ten years of tire history.

MACHINES AND METHODS USED IN THE MANUFACTURE OF THE FABRIC TIRE

The Next Great Flood—Where?

How the Study of Probabilities Aids Our Engineers in Fighting an Age-Old Menace

By Harry A. Mount

ONCE in every few years this nation is appalled at the spectacle of a great flood disaster. Johnstown, Galveston, Dayton, Pueblo—these names bring recollections of great floods of the past. Those of us who are lucky enough to escape such misfortune sympathize with the victims, perhaps give something for their relief, congratulate ourselves that we do not live in such a dangerous spot on the map—and forget it.

Few consider that there are hundreds of American communities exposed to the probability of flood in a greater degree than was Pueblo or Dayton. In a very few instances, some protective measures have been taken; in many others, scientific investigation has fully established the existence and the extent of the threat, but the community, in characteristic American fashion, prefers to "take a chance" rather than spend money for flood prevention. Still other communities are exposed to the danger of flood and do not even know it.

Disastrous floods are no new phenomenon. Records of great floods dot the pages of history since its beginning. Geologists have been able to determine that the same streams which now are menacing American towns and cities have had great floods for hundreds of years, even thousands, and that the floods which now occur are no greater in volume than those which have been. The difference is that we have built homes, factories, railroads and highways in the natural path of flood waters and now we must either hold back the stream at times, dike ourselves in, or take the consequences. Floods represent a very complex study in probabilities. The size and intensity of floods and the frequency of their occurrence are governed by a number of variable conditions. Mr. Weston E. Fuller, one of the foremost engineering authorities on the subject, divides the causes into two classes in arriving at a method for determining the probability of floods. In the first class he includes the prevailing condition of rainfall, the size, shape and slope of the catchment area, the character of the soil and vegetation of the catchment area, the physical characteristics of the stream channel, the storage capacity of reservoirs, and many other physical characteristics of the catchment area, and the stream itself. In the second class falls such conditions as the rate of rainfall, snow conditions, temperature conditions, the quantity of water stored in reservoirs, lakes and the ground at the time a flood occurs, the velocity and direction of the storm, the formation of ice dams or other temporary obstructions in the river, and many other elements which cause one flood to differ from another in the same stream.

No two floods are ever exactly alike because of the interaction of the great number of variable conditions. Thus, two storms of the same intensity passing over the same river basin may produce very different floods. One storm may come at a time when the ground is dry and the water is low in lakes and reservoirs and may produce only a moderate flood. The second, coming at a time when the ground, lakes and reservoirs are filled, may produce a large flood; or if the second flood occurs in conjunction with a high temperature when there is a large quantity of snow on the ground, a very heavy and disastrous flood may occur.

The most common protection against floods are levees to hold the swollen stream within its banks. The builders of these levees have generally overlooked the fact that embankments defeat their own end in that the higher they are built the higher the floods will go until a point is reached where the levees are high enough and strong enough to hold the maximum possible flood. Flood waters which formerly spread over large areas, are confined to a narrow channel and must, for a flood of the same volume, rise to a higher level. This has happened along the Ohio and Mississippi rivers where there are very extensive levee systems. While it is true that levees prevent a great deal of damage from small floods, when the water does break through the damage is likely to be much greater than if no levees existed. In any event, the city which builds levees high enough and strong enough to keep out all floods, enjoys its protection at the expense of other communities which have no adequate protection.

Nevertheless, there seems to be no other economical method of protecting against floods on very large streams. The only alternative is to prevent the flood in the first place by building reservoirs of sufficient size to hold back flood waters in time of danger. In the case of the Mississippi this would mean reservoirs comparable in size to the Great Lakes, and, of course, that is out of the question.

The best natural protection against floods is natural reservoirs. Throughout New England, and especially in Maine, where the country is dotted with lakes, disastrous floods are much less likely than in the Middle West where there are few natural lakes. The St. Lawrence, which originates in the Great Lakes, is an example of a perfectly controlled river.

When the great variety of conditions that may effect a flood are considered, it will be seen that the number of combinations of circumstances which may occur are infinite. When very large floods occur it is always because of the coincidence of abnormally heavy rainfall with a number of other conditions tending to floods.

What happens to the community which has given little or no thought to the question of flood prevention

One important deduction Mr. Fuller has made is that, if we can determine the average yearly maximum flood on any stream, we may reasonably expect that within a period of five years there will occur a flood 1.56 times as great, within 10 years a flood 1.80 times as great, in 25 years 2.12 times as great, in 50 years 2.36 times as great, in 100 years 2.60 times as great, in 500 years 3.16 times as great, and in 1000 years 3.40 times as great.

This does not mean that floods of these magnitudes are bound to occur in these periods, but these are the "betting chances" that they will occur. Several of the floods which have occurred in this country in the last 20 years have been larger than should have occurred, according to this table, in 1000 years.

The value of the calculation is that it enables engineers to tell with a fair degree of accuracy just how much insurance against flood a community is buying on a definite expenditure.

The most extensive flood protection project in this country is the Mississippi river levees, but these may be reckoned only as temporary protection because they are inadequate in large floods. The most ambitious flood prevention project, as differentiated from protection, is the Dayton project, which has cost some $50,000,000. Mr. Arthur E. Morgan, the engineer in charge, estimates that the protection afforded Dayton is permanent and that there is no chance whatever that ever again a disastrous flood will occur at Dayton.

It is Mr. Morgan's estimate that instead of the flood of 3.9 times the average yearly maximum that might have been expected at Dayton in 1000 years, the flood of 1913 on certain tributaries of the Miami actually was nine or ten times as great. Mr. Morgan concludes from wide experience that the whole interior portion of the United States is subject to rare local floods of very great intensity three or four times as great as Mr. Fuller's table indicates, small streams being more erratic than large ones.

As Dayton and the Mississippi levees represent the largest protection projects undertaken in this country, the city of Pittsburgh is probably the most conspicuous bad example. Pittsburgh lies at the junction of the Allegheny and Monongahela rivers and the business section of the city is on the delta between them. The low land along the rivers for miles is bordered by the great steel mills and industrial establishments.

The city has been very fortunate so far in the matter of floods, although the greater part of this low-lying area has several times been inundated within the past 15 years, with a property loss in that time of about $15,000,000. A very thorough survey of the situation completed in 1912 showed that while there was authentic records of 53 floods in Pittsburgh ranging from 22 to 35.5 foot stages, it was not improbable that some day Pittsburgh may have a 40-foot flood which would cause a disaster equal to anything this country ever has seen. In the past the city has always been lucky that only one at a time of the streams which meet there has been flooded to an extraordinary degree. When it happens that both have great floods at the same time, Pittsburgh will be a sorry city.

A system of dams above the city, similar to the scheme carried out at Dayton, was proposed and the cost at that time would have been about $20,000,000. It was shown that the assessed value of the land affected was $160,000,000 and that this property was nearly $50,000,000 lower in value than if it was protected from floods, but the project got no further than discussion. According to Mr. Fuller's table the floods which Pittsburgh has had within the past 50 years have been no greater than might normally be expected in a period of 15 years.

It is probable that large cities, such as Pittsburgh, will eventually learn from bitter experience that flood prevention is cheaper than floods. When a number of the tributaries to the large streams are controlled the danger of bad floods on the large streams will be reduced and thus at some distant day we may expect the number of disastrous floods to be reduced in this way.

But the threat of flood to hundreds of small communities which now exists probably will continue to exist and whenever the fatal combination of circumstances occurs, we shall have another flood horror.

Flowers That Dislike Music

IT has been recently observed that several kinds of flowers are very much affected by music. Where there is a constant volume of sound for some hours during the day certain sensitive blossoms develop a leaning tendency away from the direction from which the music comes. It has been shown that the cyclamen and the carnation are especially susceptible to the influence of music. Some of these which had been used as floral decorations close to a stand where a jazz band was frequently playing dance music, were affected to an astonishing degree. After a few hours it was discovered that all the blossoms had deliberately turned their backs on the source of the music. Even when they were placed facing the stand it was not long before each bloom reversed its position. Flowering specimens of the white Easter lily were also affected in the same way. Although little is known at present about this curious phenomenon there is no doubt that blossoms of several kinds are affected by the vibrations which are set going when music is performed.

Does Steel Melt from the Inside?

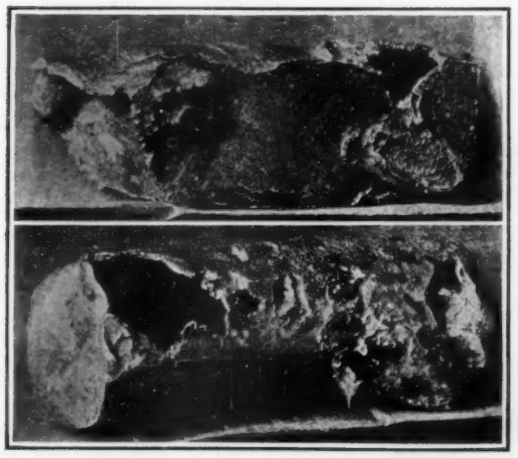
MR. G. P. BLACKISTON, of Canton, Ohio, sends us the accompanying photograph of some metal which he was melting, some twenty years ago, in a crucible steel plant. In the manufacture of crucible steel, he reminds us, the mixture to be melted consists of definite and carefully weighed amounts of certain grades of wrought iron, blister bar, alloys, and scrap, which are placed in pots. These pots, when filled and covered, are placed in a furnace which contains a number of holes—six pots, three deep and two abreast, being placed in each hole. The holes are then covered and the pots are subjected to a heat of 3000 degrees Fahrenheit for a period of from two to three hours. After the mixture is melted, the pots are allowed to stand in the furnace until all the gas has boiled out. The molten steel is then ready to be cast.

The mixture used at the time that the incident occurred included numerous pieces of octagon bar steel, such as is used for chisels; and rectangular bar steel, such as is used for lathe and planer tools. After the pots had been packed, placed in the furnace, and the melting was well under way, one of the pots broke and was immediately removed from the furnace and set to one side. When the pot had cooled, Mr. Blackiston observed that chunks of metal were present, which seemed to have the original shape they possessed at the time they were inserted in the pot. By tapping them with a hammer a hollow sound was noticeable and upon further investigation the pieces were indeed found to be hollow. They were carefully removed and are shown in the photograph. It will be observed that the pieces removed from the pot are two hollow shells that have retained their original contour, except that in the process of melting the molten metal in the inside found a weak spot in the outer shell and passed out through the opening shown. Mr. Blackiston asks whether this does not suggest that these pieces of steel melted from the inside to the surface and not from the surface to the interior, as is generally supposed.

Now we are of the opinion that the explanation of the curious appearance of this specimen is to be found in the fact that metal carrying a high percentage of carbon has a lower melting point than a low-carbon metal, such as wrought iron, and that the tool steel melted before the other contents. Before a charge of metal in a furnace passes into the fluid condition, it assumes a pasty semifluid condition, and furnace men tell us that sometimes, in an open-hearth furnace, when the charge is slow in melting, or, because of a temporary drop in temperature, begins to thicken up, it can be quickly brought to the fluid condition by introducing a mass of cast iron, which, because of its high carbon content, serves to hasten the melting.

Probably, in the case before us, the miscellaneous material in the pot had reached the half-melted condition, and the pasty material formed around the hexagon tool-steel, forming, as it were, a matrix or mold. Then as the temperature rose, the steel melted and ran out of the matrix of more refractory lower-carbon material, leaving a hollow space, corresponding to the original shape of the tool steel. At this point, before the whole mass was melted, the pot broke and was withdrawn. If this was the sequence of events, it will explain the curious appearance of the contents.

A metallurgical engineer to whom we showed this photograph is of the opinion that the octagonal shell, upon analysis, would probably be found to be neither tool steel nor soft steel, but something of a conglomerate of the two.



Hollow pieces of tool-steel scrap, found in broken crucible pot after partial fusion, which apparently proceeded from the inside, out

Storing Gasoline Under Pressure

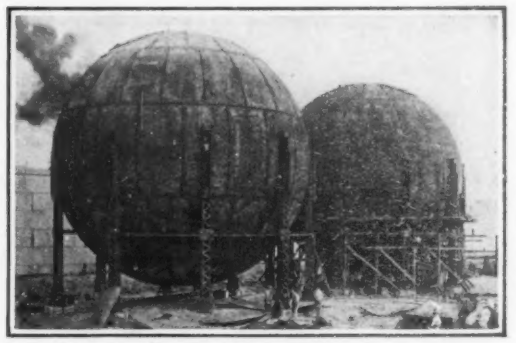
OWING to its high volatility, gasoline must be stored under pressure if it is to be kept from season to season without great loss by evaporation. But the ordinary flat-bottomed cylindrical storage tank has a great handicap—it cannot be kept gas-tight. It soon becomes distorted under pressures of fifteen or twenty pounds per square inch, the bottom sagging down in the center. At the same time the perimeter rises. Leaks sufficiently large to keep a constant stream of gasoline vapor passing off from the tank develop as a result of the distortion of the tank and within a few months the stored gasoline has lost its most valuable properties.

To obviate these troubles a Chicago manufacturer has invented and built a perfectly spherical storage tank of steel which is able to withstand the pressure due to the weight of the liquid as well as the superadded storage pressure without suffering any distortion. This type of tank is known as the "Hortonsphere," and those now under construction are about fifty feet in diameter and have a capacity of 10,000 barrels.

In order to protect the sphere against too high pressures due to the absorption of solar heat, with consequent rapid vaporization of the contents, the tank is covered with a thorough surface insulation, while to this is added a coat of white paint, intended to reflect a maximum of sunlight away from the tank.

The tank weighs about 140 tons, but its full load of gasoline adds another 1250 tons. Ten heavy posts carry this weight to the foundation piers. These posts are made of fifteen-inch channel sections and are riveted at their upper ends to the center ring of the tank. The tank itself is not welded but is calked on the outside.

It is a mathematical fact that stresses in a sphere for a given pressure are only one-half what they are in a cylinder of the same diameter. In a cylindrical steam boiler the metal in the sides is subjected to twice the tension in one direction that it is in another. Both ends of the boiler are pulling equally hard in an opposite direction, doubling the stress in its longer direction. The same fault exists in the cylindrical pressure storage tank for gasoline, but the spherical tank gets around this drawback.

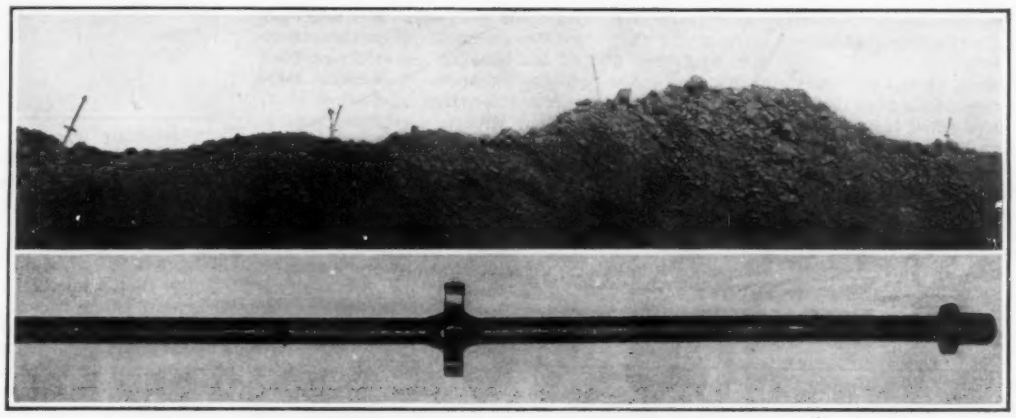


Round tanks for storing gasoline under pressure without loss through leakage

The Spontaneous Combustion of Stored Coal

BECAUSE of the danger of its loss by spontaneous combustion the managements of large industries often hesitate to keep enough coal on hand to take advantage of lower prices during certain periods of the year, to insure against interruptions of supply which entail costly shutdowns and to insure against excessive prices during fuel shortages. All coal is subject to the phenomena of spontaneous combustion, and it is due to local conditions prevailing in certain portions of the pile where a balance is struck between insufficient air and excess of air. It is therefore a local condition occurring in a small spot and if allowed to progress, spreads through the pile. Dangerous heating generally occurs between two and ten feet from the surface. All coal heats some; but if the heating temperature does not exceed 125 degrees Fahrenheit no danger exists. But 150 degrees is the danger point.

It is stated by a Jersey City, N. J., manufacturer of a device called a protectometer that odor and smoke are not safe means of detection, for when the coal reaches this stage it is well along in the process of combustion. If the small part of the pile where the combustion originated can be located, the simplest solution is the shovel. How, then, to locate the hot point? By inserting in the pile on centers of 15 or 20 feet a number of these "sentinels." These consist of pointed tubes each containing a link of such a composition that it is fusible at 150 degrees. When the link melts out a signal head is released, which after it springs up is visible for several hundred feet. A somewhat similar device is used for sounding around critical spots and watching them. Instead of the fusible link it has three thermostatic elements at three points in its length, and these connect with dial thermometers mounted on the head of the protectometer.

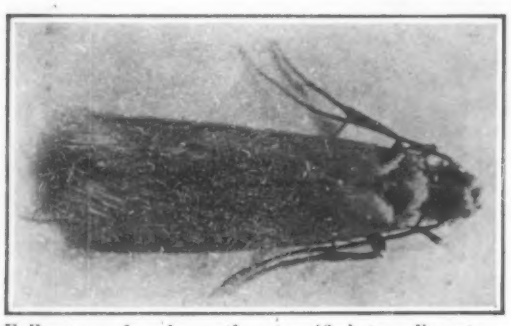


The "sentinel" that gives a visible indication when the temperature of the coal pile rises beyond the safety point; and a big coal-dump protected by these devices against the ravages of spontaneous combustion

Each sentinel can guard from 100 to 300 tons of coal, and with a group of them inserted in a large storage area any member of the working force can glance them over at reasonable intervals in a few seconds. The general use of such devices as this would tend to enable the railroads to transport coal in good weather when cars are available, and to give steady employment to miners rather than the present seasonal employment. This should lower the price of coal and remove the ever-present fear of having to close down large industries because of temporary coal shortage.

Hereditary Immunity to Disease

IN a recent paper read before the American Philosophical Society, Professor M. F. Guyer of the University of Wisconsin stated that by inoculating successive generations of rabbits with the germs of typhoid fever he was able to develop in their blood an antibody which is transmitted from mother to offspring and renders them more immune to the disease. Rabbits of the fourth or fifth generation so treated may be made capable of overcoming an injection of thirty to forty times as many typhoid bacilli as the original rabbits could stand. Whether such acquired immunity is also transmissible through the paternal side has not yet been determined but as Professor Guyer says: "It is of interest to learn that young may not only acquire immunity reactions from their mothers, but may retain them sufficiently to transmit them in a measurable degree, without further immunization to their offspring. Even if this is nothing more than maternal transmission it may be of practical importance, since a large percentage of a population might in time through such transmission come to exhibit some degree of immunity to a widely prevalent disease. If the results of our future experiments bear out our present data it becomes evident that when succeeding generations of rabbits are immunized to typhoid bacilli, some modification is made in the immunity mechanism whereby individuals of later generations are capable of developing higher resistance against these germs."



Full-grown female moth, magnified ten diameters

Checkmating the Moth

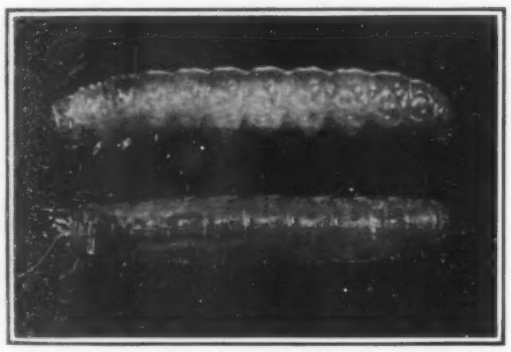
New Investigations of the Life Cycle of this Insect and the Possibility of Preventing its Ravages

By Dr. Albert Neuburger

ALTHOUGH the moth belongs to the "domestic animals" (though not to those we wish for) and does much harm to our wardrobe and our furniture all the year round, zoological research had not succeeded as yet in finding out the secret of its life and its propagation. The reason of this fact is, that certain details of the moth life-cycle are very difficult if not impossible to be observed, though great numbers of moths fly about everywhere continually. In consequence this mischief-maker could not be fought successfully. Different strongly-smelling chemicals were used (camphor, naphthalene, etc.) because it was expected that their smell would keep off the moths—whereas it was not even certain that these animals possess the faculty of smelling. Moths have been seen crawling about on bales of naphthalene—on the other side good experience was had with these and similar chemicals.

This contradiction may be explained by the fact that there are different species of moths, which also differ in their customs of life. Thus, there exist, besides the clothes-moth which only resides in clothes and furniture, a paper-moth which destroys books and wall papers, a leather-moth eating leather, a fur-moth, etc., etc. All these different species belong to the same family of butterflies—to the Tineidae. But they are found not only in the clothes of mankind, that is, in wool, leather, paper and furs, but also in grains, on some trees and single species occur on apples and even in bee-hives, where they sometimes happen to be in such multitudes, that the whole hive is destroyed and the bees swarm out to found a new home elsewhere.

As mentioned above all the details concerning the life of these animals were not very well known until now. But according to modern views, the combat against an animal or a plant doing harm can only be led successfully, when its customs of life are known to us in full detail. Nowadays the combat is led on a purely physiological basis, whether it concerns bacteria, parasites or whatever it may be. All single phases of its life are investigated, after which every possible means are applied to make its survival difficult or impossible.



Full-grown moth caterpillars, likewise magnified ten times

Concerning the moths, the zoologist, Dr. Titschak, at Leverkusen, has made detailed researches, which have had remarkable results. To begin with, he has stated that it is of relatively little avail to catch moths that fly about in the room and kill them. For these moths are always masculine. The feminine moth, whose destruction is much more important, does not fly often, because the back part of its body is too heavy for flying. This back part is considerably larger than the one of the masculine moth and is filled with eggs to the greater part, so as to be like a heavy sack. For this reason, the female sits generally quietly in a hidden corner. It moves little, and generally crawls about slowly. If it ever flies, it does so much slower than the male and with a slower flapping of the wings. For this reason, there will be rarely an opportunity to see a female moth flying, or even to find one at all, the more so, as they are rather scarce. To about ninety or a hundred males there is perhaps only one single female moth. That is why the catching of the males is of so little value, as there are always enough which remain living and know how to find the rare female, which men will generally not be able to see.

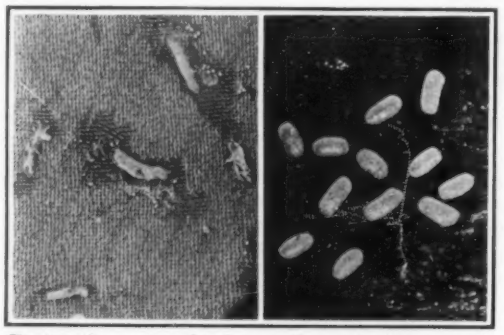
To find the ova and the greedy caterpillars which crawl out of the ova, is as difficult as to find the females. Both are less than a millimeter long. The caterpillar grows though, but when it is big enough to be seen by sight alone, it is generally too late. The female does not lay its ova directly on the material, the clothes, the furniture, etc., etc., which are spoiled so badly later on by the caterpillars. Quite on the contrary, it lays them in some corner, in small cracks of the floor and such like places, where they are neither looked for nor to be seen at all. From them the wee caterpillars crawl out. When laying the ova, the female does not provide for food somewhere near them. Thus the caterpillars begin to wander and to look for food. The females have died after having laid their ova and as their bodies are generally to be found near the place where they laid their ova, they are generally eaten up by their own descendants. Then these wander, until they find at last woollen materials or furs, or if they are cork-moths, stoppers of bottles. Here they have what they looked for, that is, food.

Now they begin to feed with a greediness that is astonishing. The holes in the materials grow bigger and bigger and with them the caterpillars grow and reach at last the length of a centimeter. But it may be a year before they reach this size. As they take their food only from these materials and eat nothing but these, the size of the holes in these materials corresponds with the size of caterpillars in every respect.

When the caterpillar is observed, it is often too late, for it has then already done great harm. It is singular that it knows well how to differentiate the materials in eating, for in mixed woollen materials which consist of wool and cotton, it eats the wool alone and leaves the cotton untouched.

When the caterpillar has lived for some time and has reached a certain size it begins to pupate. To form the cocoon it uses its own excrements mixed with wool, horse hair and such-like material. The cocoon will stick fast to clothes, covers, carpets, etc., to which the caterpillar has fastened it. From this cocoon the butterfly comes forth and the cycle of life as described here begins anew for another generation.

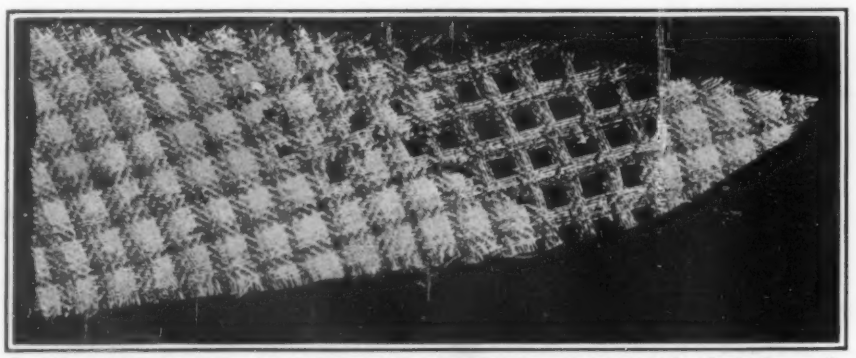
The researches which Dr. Titschak continued for years, which have just been finished, and the results of which we have reproduced pictorially, show what enormous difficulties arise when we strive to destroy the moths. Frequent beating, which is recommended, is certainly useful, but will not remove the caterpillars from the materials to which they are firmly attached by their trophi; nor will it remove the well-fixed cocoons. If the garments are beaten much, of course the number of caterpillars will be greatly diminished by and by. But a certainty that they all have disappeared is not given. Even when looked over ever so carefully, young and small caterpillars will be overlooked. When the pieces are locked into a moth-proof case after they have been beaten, there is the danger that not all the caterpillars have been removed by



Destruction wrought by moth caterpillars, and ten-fold magnification of the eggs from which they hatch

beating, and that those that remain continue their work of damage within the case. But, of course, a well closed box is a good protection against the immigration of new moths. Dr. Meckbach calculates the value of the wool eaten by the moths in Germany as many millions of gold marks yearly. But the whole damage is, of course, a much larger one than the value of the wool as in many cases clothes, furniture, etc., are damaged which lose in value by the holes the moths have eaten. The effect of many strongly smelling chemicals appears to be doubtful as mentioned above and there remains the open question how to prevent the damage by moths.

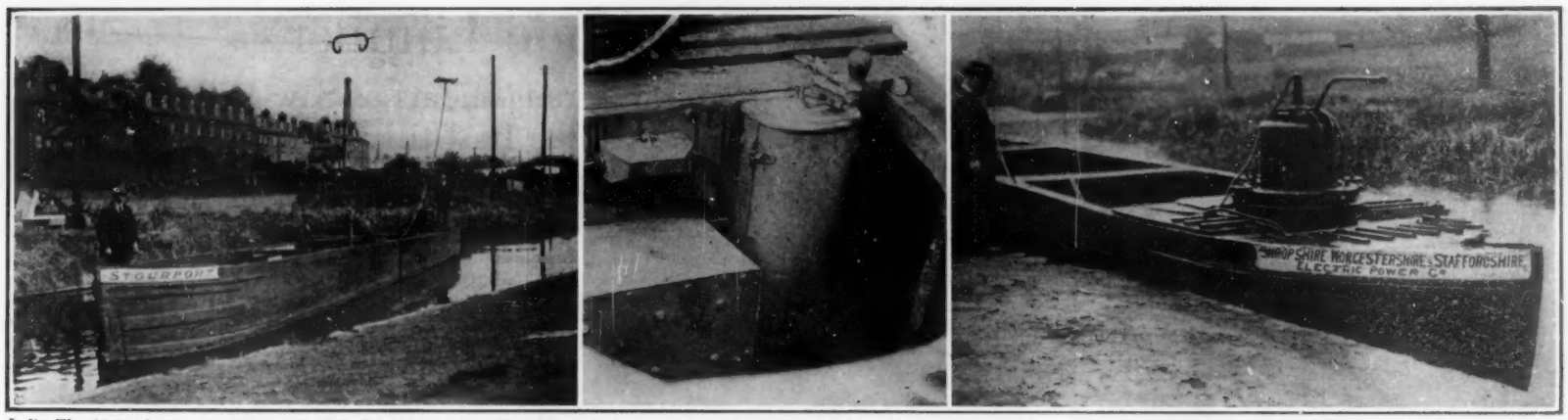
On the basis of his physiological researches concerning the customs and the generative faculty of the moths Dr. Titschak asserts that it is best to keep food from the caterpillars, so that they perish by hunger. The simplest method of doing this is to combine the wool with a substance that makes it inedible for the caterpillars. It is very hard to find such a substance which, of course, must be without any smell, not to make it disagreeable to wear the clothes or to remain in the house; and which may not influence either the colors or the qualities of the wool. It must be possible also to treat water-proof material with it. After Dr. Titschak has tried more than 2000 chemicals, he has succeeded in finding one that would fill the bill. Threads, textures, felts impregnated therewith show no trace of this treatment after drying. They look the same as before, they manifest no objectionable ordor, they are soft and pliable and have not changed in any way. But the caterpillars put upon them do not touch the food any more, and quickly perish with hunger.



Textile fabric of half wool and half cotton, showing the precision with which the moth caterpillar selects its food

Slag Concrete Roads

SLAG as concrete aggregate has been used in concrete roads for something like nine years, and there are about 225 miles of such roads now in use in various parts of the United States. In some places this is the most economical and most easily obtained aggregate; but many engineers and contractors lack confidence in its wearing qualities. Extended observation of slag-concrete roads in construction and operation, recently made, indicate that while this material presents peculiarities as to original manipulation and as to wear, roads built with it are in substantially as good condition as those of comparable age using natural aggregate.



Left: The 25-ton barge, showing overhead trolley wires and trolley from which current is obtained for driving the jet-pump. *Center:* The controller for starting and stopping the motor. *Right:* The power unit, consisting of an 18-horsepower vertical electric motor, direct connected to a centrifugal pump. It revolves in a well, thus enabling the barge to be steered

The English canal-barge that is propelled by the water-jet system

Water-Jet Propulsion

ONE of the favorite subjects for the efforts of would-be inventors is the propulsion of ships by means of the reaction from jets of water directed astern. This system has the advantage that it works, and the disadvantage that it is decidedly inefficient. An installation of the sort has, however, been made in England and the peculiar circumstances under which it is used fully justify the loss of efficiency.

The Midlands canals are very shallow and have become somewhat obstructed with underwater growth of weeds. The customary horse towage has become too expensive, while the shallow canals make use of the screw propeller impossible. A Norfolk manufacturer of propellers was therefore given the opportunity to design a special propelling unit having a water jet made by an electrically-driven centrifugal pump.

Into a cylindrical, open well built into the bottom of the barge and reaching through to the deck is telescoped the power unit which consists of an 18-horsepower electric motor direct connected to a 10-inch centrifugal pump, both on a vertical shaft. This unit is carried on ball bearings in such a manner that it may be rotated by means of a tiller. In this manner the barge may be steered without a rudder, simply by turning the water jet. In addition, it may be stopped or reversed by swinging the tiller through an arc of 180 degrees.

Owing to the fact that grass would quickly plug the intake opening of the pump, the latter is provided with a number of guides; while immediately below these guides is mounted a bar having a sharp cutting edge. When weeds collect on the intake a quick movement of the tiller, or simply the ordinary steering movements, suffices to cut them between the guides and the bar.

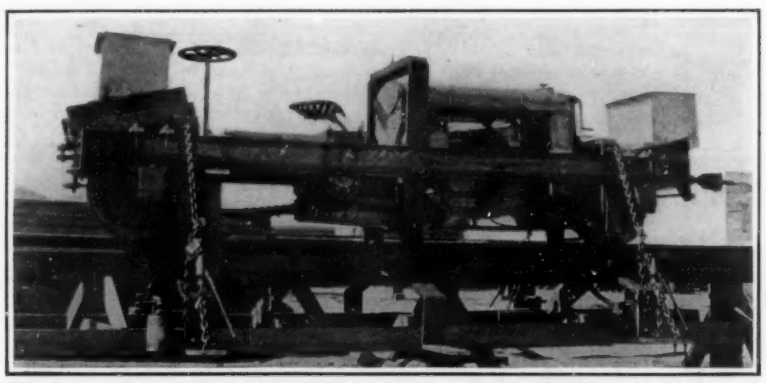
The supply of current for the 18-horsepower motor is taken from two trolley wires suspended over the canal. With the motor consuming 12 horsepower a speed of 3½ miles per hour was given to a 70-by-7-foot canal barge having a nominal load tonnage of 25 tons, and the cost of power works out at one-fifth of a cent per ton mile. The cost of the overhead trolley wires was about £600 per mile. Allowing for capital cost, the working expenses of the electrically-propelled barge are about half those of the horses whose place the installation takes.

The weight of the complete installation is 2400 pounds and it can be transferred in a few minutes to any other barge which is equipped with the necessary well.

Old Egyptian Water-Clocks

SEVERAL ancient time-observations, such as the statement of the equality of day and night at the equinoxes, make it clear that some form of clock was employed. It is therefore interesting to note that casts of two Egyptian water-clocks have lately been presented by the Egyptian Government to the Science Museum, South Kensington. One, from Karnak, dates from the reign of Amenhotep III (B. C. 1415-1380); the other, from Edfu, is of the Ptolemaic Epoch; in the former, time is measured by the uniform escape of the water; in the latter, by its uniform admission. In each case there are twelve different scales, corresponding to the length of the night or day in different months. Each of these scales is divided into 12 equal parts, showing that an "hour" was at first of variable length, being one-twelfth of the length of the day or night at the particular time of year.

Claudius Ptolemy collected the observed times of the phases of a number of lunar eclipses; these were used by several investigators, including Newcomb, Cowell, and Fotheringham, in studies of the moon's secular acceleration. As the times were presumably observed with some such instruments as those now exhibited, their study, with an estimate of their accuracy, is of some astronomical importance.



The locomotive of the monorail line, showing the double-flanged wheels and the low-hung center of gravity as the rail is straddled

Conquering Excessive Grades and Curves with a Monorail Line

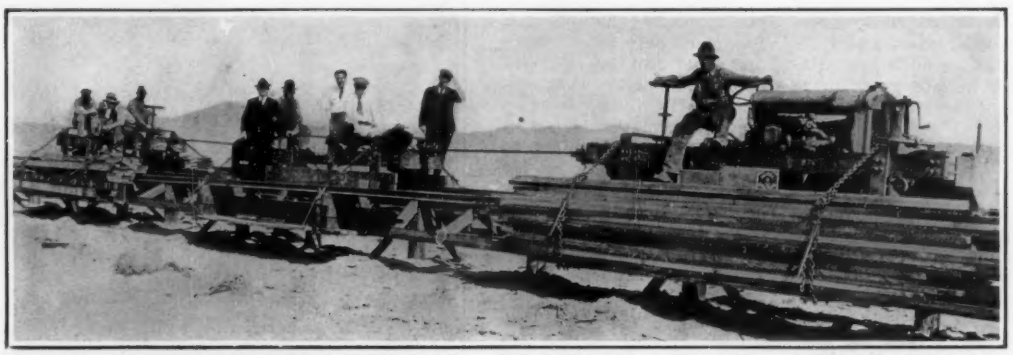
IN building in to tap a magnesium sulfate deposit situated far back in the mountains of southern California, it was decided that a monorail railroad would be the most practical type of construction. In preparing for such a line very little grading would be required and furthermore there could be incorporated curves of a degree of sharpness that, with other types of construction, would have to be trimmed down.

At the present time, about 19 miles out of the 28 being constructed are under operation. This road is being operated with Fordsons, carrying a load of approximately three tons, and five tons on a trailer. The company has two of these and has just installed a Buda engine on No. 3, which has worked over the road a few times. It is a pleasure to watch this engine make 10 per cent grades and 50-degree curves; she has loaded herself with at least four tons, carrying a five-ton trailer, and pushing a lumber car with at least five tons on it, making a total of something over 15 tons to a trip. This engine makes these grades and curves in second speed. Just how large a load the engine will pull has not been determined, but the company feels sure that the tractor would come over the hills with 16 tons of material, besides its own weight.

During the month of October the foreman, with 30 men, completed four miles of road that was very rough, and a great part of these men were on the shovels, owing to the rocky washes that were encountered. Standard ties are used, placed on eight-foot centers. Each bent consists of a single plumb post placed in the center of the tie and braced on either side. On the plumb posts is a stringer supporting in turn the single 50-pound rail. The timber side rails serve as guide rails. Their faces make contact with the rollers on either side. These rollers serve to maintain the equilibrium. The engine and cars are designed much like a pack saddle; they are suspended on two wheels from the single rail, with heavy overhang as illustrated. The tractors are chain driven from both the front and back wheels.

It is felt that this type of road has several advantages for desert hauling, where grades and curves hamper a two-rail line. The safety over cloudburst territory is well taken care of compared to a surface line. This structure stands 34 inches to the top of the rail above the average level of the ground. The ore cars clear the ground on the sides about six inches. There have been several wonderful demonstrations of safety on this line. On these very severe grades on several occasions the train crew has lost control of their train, and the trains have started down over these grades and curves at a high rate of speed, loaded. In setting the rail brakes, the crew would then set them so hard that they would raise the double-flange wheel so high that a sharp curve would throw not only the wheel but also the brakes off the rail. In this event, the wheels would leave the track, but never have the cars or trailers left the structure or done any damage, outside of breaking a few guard rails. However, the company now has safety devices in use which prevent the cars from being thrown off the rails at any rate of speed, no matter how violently the rail brakes may be applied.

The cost of building a mile of this monorail road varies from $5000 to $7000, according to the territory passed through.



Complete monorail train ready for action. Even when the wheels rise clear of the rail, the timber side-rails and the deep straddle keep the train on the right-of-way

Man-Made Lumber

Revising the Structural Arrangements of Saw-Mill Waste to Make Possible Its Utilization

By Howard F. Weiss

Wrapping the home in fire-proof balsam-wool gives the owner a 30 per cent saving in fuel and makes the house healthier and more comfortable

CELLULOSE is the structural material out of which the frame-work (trunk, limb, and twigs) of all trees is built. Its chemical composition is fairly uniform, but as it occurs in trees, it has associated or combined with it a variety of other compounds such as lignin, pectin, suberin, etc., all of which impart to the natural or ligno-cellulose a variance in color and chemical properties.

The physical form in which cellulose is built up by the growing trees varies even more than its chemical. In certain trees it is developed into long hollow tube-like cells, or into short hair-like fibers, or in dense thick-walled and more or less circular "stone cells," or at times into delicate, brick-shaped, pith-ray cells. It is these variations in the chemical and physical structure of the cellulose formations that enable the identification of the various woods with scientific accuracy and which also determine the commercial uses to which the various woods are put.

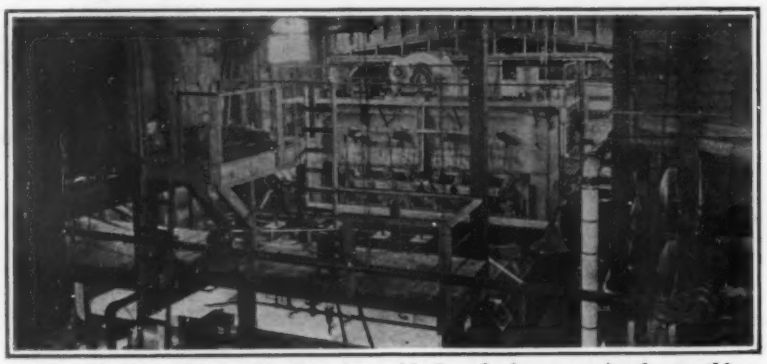
Two great primary industries have been developed in this country that are dependent entirely, or almost so, upon the cellulose structure of trees for their existence, and from these two primary industries a host of others in turn derive their existence. The combined result is that millions of dollars of capital are invested in, and hundreds of thousands of American workmen derive their living from, changing the cellulose structure of wood and converting it into forms suitable for modern industrial requirements. These two great industries are the paper industry and the lumber industry, both of them the primary feeders for an enormous tonnage of commodities intimately identified with our daily existence.

Although both of these industries use the same raw material, namely living trees, they differ almost at the very start in their method of operation. This difference occurs even in the logging operations and it is seldom that logs for lumber and paper mills are gathered at the same time, although in late years there has been a tendency to consolidate these operations to some degree.

The main difference between the sawmill and the paper mill process is that the sawmill changes the cellulose structure only in mass, while the paper mill is not satisfied until it alters the form of the minute and individual tree fibers and often their chemical structure as well. Thus, one industry deals with the tree in large units, while the other industry dissects the tree to individual and minute particles. Because of this, the paper industry is able to use trees with a much wider variance in size and shape than the sawmill industry and it furthermore can change the chemical and physical structure of the wood fibers so that its finished products, even from a great number of different trees, are all of uniform grade and quality. This is not so true of the sawmill, the finished products of which reflect directly the inherent characteristics and properties of the individual trees from which they came.

In the conversion of round trees into square-edged lumber, much wastage or offal is bound to occur. This takes the form of slabs, edgings, sawdust, shavings, etc. Some of this offal is used for fuel, but much of it finds its way to the burner and is destroyed. This is the practice at most sawmills now operating in the United States and as a result it has been estimated that some forty or more millions of cords of wood are each year filling the air with no more valuable product than smoke.

About five years ago some lumber companies popularly referred to as the "Weyerhaeuser group," engaged the C. F. Burgess Laboratories to work upon this sawmill offal problem and see what, if anything, could be done to utilize it in some practical manner. Numerous plans were considered, such for example, as the manufacture of briquettes, the production of ethyl alcohol, wood creosotes and oils, organic acids, etc.; but all these proposals had such limitations that their commercial development did not appear particularly promising. Some researches were then started with the object of embracing the more desirable features of the two primary wood-using industries mentioned above, namely, the lumber and paper industries. The question was asked: "If trees can be picked to individual fibers and these then put together again in thin sheets called paper, why cannot the trees be picked to pieces and put together in thicker sheets called boards, and thus actually make boards by altering the individual fiber and cell structure?"



Interior of plant that makes four-foot-wide boards from previously worthless slabs and limbs, making 20-year-old timber serve in place of 150-year growth

Search for an answer to this question finally led to the development and manufacture of two new commercial products from living trees. In order to carry on the commercial developments of the laboratory, the Weyerhaeuser companies organized a separate by-product company, and this company built two plants at Cloquet, Minnesota to manufacture the new products.

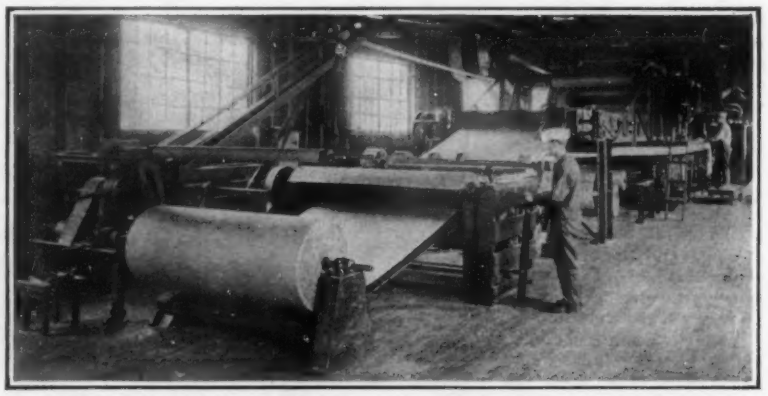
The first product to reach commercial development was a flexible, resilient, felt-like product called balsam-wool. It weighs only four pounds per cubic foot or one-third as much as cork. This very unusual lightness accounts for the remarkable resistance balsam-wool offers to the passage of heat, as the entire product is nothing but a mass of entrapped air cells and cavities in which all air circulation is almost entirely eliminated. It allows only 6.1 British thermal units to pass through one square foot of its surface per one inch thickness, per one degree temperature drop in 24 hours. Expressed in another way, a layer of balsam-wool only one-half inch thick, offers four times as much resistance to the escape of heat as maple or oak lumber of the same thickness. This puts balsam-wool into the same "warmth-giving" class of products as sheep's wool and the best of the hair felts, and very much better than products made from flax, cork, and other fibrous materials.

Balsam-wool is made from living balsam, spruce and pine trees, the woods of which even when in a thoroughly dry condition, weigh over 20 pounds per cubic foot or more than five times that of the finished balsam-wool made from them. This great reduction in weight is brought about by cementing the individual fibers together after they have first been picked apart from the natural wood, so that in their rearranged condition they extend in all three cubical dimensions rather than in only two dimensions as occurs in forming a sheet of paper. In fact, the first steps in the manufacture of balsam-wool are not unlike those practiced in paper making.

The sawmill offal is first freed of foreign particles, such as stones, iron, etc., and then cut into small chips, which are run into a steel digester and cooked in the presence of an alkali, until the cementing material binding the fibers together is loosened. The partially cooked chips are then mechanically beaten so that the fibers are knocked apart and the wood becomes a mass of individual fibers floating in water. In this condition the individual fibers are then treated with a fire-proofing compound so that they will not burn if exposed to flame. They are then formed into sheets or laps and the moisture content reduced to air dryness, after which they are subjected to a very violent beating, which knocks the fibers apart in air and causes them to form a cloud of individual fibers. In this condition they are picked up by a large fan and blown through distributing hoods against a moving screen. These distributing hoods are so designed that the fibers are deposited upon the screen in a continuous and uniformly thick blanket six feet wide. As the fibers pass from the distributor hoods to the screen they are blown through an atmosphere of cement in a highly atomized condition, which causes the fibers to cement themselves together when they strike the screen.

Now, unlike paper, the axes of the fibers extend in all three cubical dimensions, and this feature accounts for the remarkable porosity and extremely low density of the finished product. The traveling screen then carries the blanket of fibers through a dryer where the water is evaporated and the fibers dried. When the blanket emerges from the other end of the drier, the fibers are thoroughly dry and cemented together in an endless blanket about six feet wide and one and one-half inches thick. At this stage, two sheets of tough kraft paper coated on the inside with a thin film of water- and moisture-proof asphalt are pressed against the blanket of wood fibers, and

(*Continued on page 296*)



The endless blanket of balsam-wool emerging from the machine

Machine-Gunning Auto Bandits

THIEVES, after committing a holdup or a robbery, are able to flee in motor cars because a policeman armed with only a regulation pistol, while pursuing the bandits, finds it difficult to shoot straight and "wing" the outlaws. This condition has caused the police departments of several of our large cities to adopt the submachine gun invented by General John T. Thompson, who was director of arsenals and chief of small arms production during the world war.

In order to show the effectiveness of this gun during a bandit chase a demonstration was recently carried out at Tenafly, N. J. The weapon was mounted in a side-car of a motorcycle and operated by a policeman. The motorcycle pursued a seven-passenger motor car supposed to contain thugs attempting to make a getaway. The auto was towed by another car a safe distance ahead. These two were running at a fast clip and the motorcycle was about 50 yards to the rear. The submachine gun operator opened fire on the "bandits'" car and a hail of .45 calibre bullets punctured its tires full of holes, bringing the machine to a halt. It would have been an easy matter for the officer to hit any one sitting in the automobile and if the crooks, armed with the best automatic pistols, had tried to shoot the pursuing officer they would have found it extremely difficult to "get" him at a distance of 50 yards. The odds were heavily against them from the moment the anti-bandit gun opened fire.

A demonstration was also made to show what the gun can really do to an automobile when this becomes the target of automatic firing. At a distance of about 30 feet three of these guns blazed away simultaneously at the touring car just referred to and while it remained stationary. Counting the combined fire of the three weapons, bullets poured into the car at the rate of over 2000 per minute. And this fire reduced the machine to a pile of junk in less than a minute's time. The tonneau was perforated till it looked like a Swiss cheese; the radiator was ripped to pieces, and the gas tank and the steering gear were utterly wrecked. Finally an incendiary bullet was shot in the spilled gasoline and instantly the car was a mass of flames.

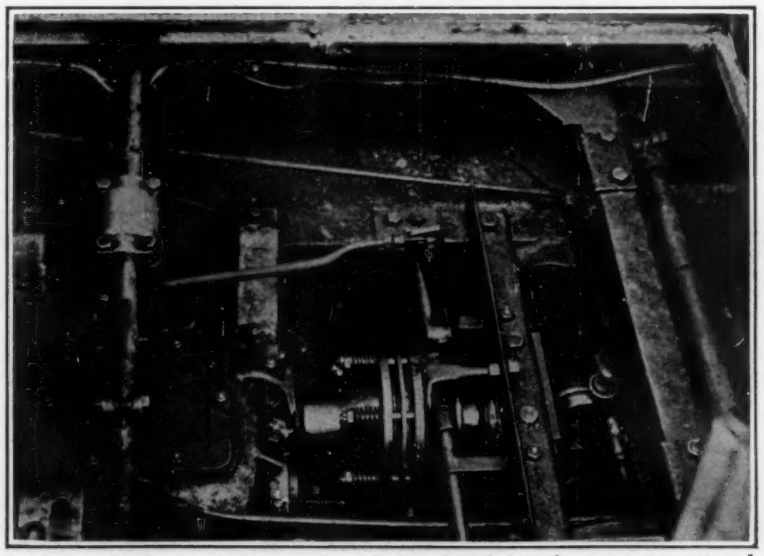
The anti-bandit gun has been made practical and safe within densely populated districts by the introduction of birdshot cartridges. The latter, in conjunction with the marked accuracy of the weapon, insure the safety of innocent bystanders beyond the range of a few feet. The birdshot cartridges will inflict severe punishment on a crook without fatally wounding him.

The gun weighs only 9½ pounds and is, therefore, the lightest rapid-fire gun in existence. The next lightest automatic gun weighs 18 pounds. The weapon can easily be held in one hand and fired accurately. It comprises but 38 parts, as against 225 parts in the next simplest full automatic gun. The gun is both a single-shot as well as a full automatic weapon.

Submachine gun mounted in police side-car

Certain Gear-Shifting With a Foot-Loose Gear-Box

EVEN though gear boxes are nowadays so designed as to call for a minimum of skill from the driver, attention is always turned to devices that aim to eliminate entirely the human element from this important feature of automobile operation. Mr. A. E. Saxon, of Blackpool, England, achieves this end by means of a secondary clutch behind the gear box, supplementing the usual clutch between engine and gear box. The operating mechanism of this clutch is tied to the clutch pedal along with that of the regular clutch. When the pedal is depressed in the usual way, both clutches are disengaged; and the members attached to the gear-box shaft are then brought in contact with clutch brakes, bringing them to rest rapidly. After engagement of the desired speed, the pedal is released, and the drive is transmitted through the two clutches. This makes not alone for fool-proof and fumble-proof shifting under ordinary circumstances; but when the car begins to get out of control on a hill, it permits a shift to a lower speed for the purpose of braking with the engine, at any speed at which the car may be rolling. It is the simplest application we have seen of the multiple clutch idea, most devices in this class having what amounts to a separate clutch for each speed. Mr. Saxon tells us that he has driven his car, so equipped, for 5000 miles with no trouble and no alteration.



Auxiliary clutch at rear of gear-box, designed to bring the gears to rest and permit easy shifting at any car speed

Fabric Bodies of Novel Type

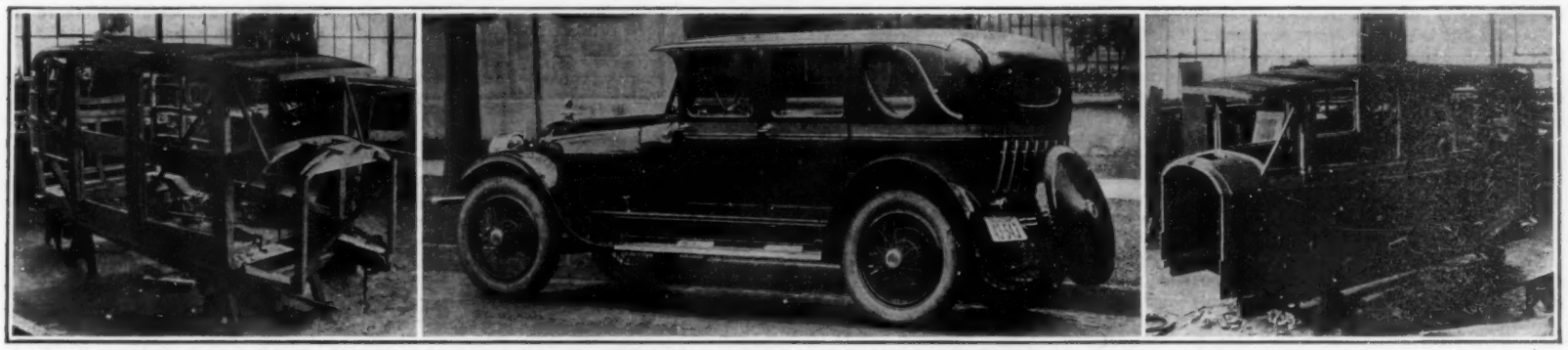
ONE of the most interesting novelties at the Paris show was the display of fabric bodies for closed cars. Lightness, durability and economy in construction are claimed for them. The new type has the great advantage of requiring a comparatively small investment for machinery; the labor cost is also lower. This will enable the car manufacturer to bring out his closed models at a price that will appeal to a larger public than at present.

In this country a fabric body was shown at the annual Automobile Salon held in New York in November, winning the approval of the well-to-do class of motorists who constitute the principal clientele of that exhibition, and the interest of factory executives who also attended. K. L. Childs, inventor of the fabric body developed here, has subjected one of these jobs to a very satisfactory 12-month test, during which it was driven some twenty thousand miles.

The fabric body in Europe is built on what is called, after its originator, the Weymann System. It is an extremely light body, with wooden frame members that do not touch each other but are joined by metal plates. There are no longitudinal sills, and the seats and floor boards rest directly on the chassis, so that the body supports only its own weight. It consists of a light frame over which the fabric is stretched.

The American fabric body, built on the Childs System, is far more substantial in construction and durability. It has the conventional wood frame construction used in standard practice, with the addition of a few thin, light, strainers where panel contours are required. Instead of the customary wood or metal panels a two-mesh No. 19 gage galvanized wire is stretched over the frame, upon which are placed two layers of cotton wadding, which are tensioned into the wire by stretching over them tightly a number ten canvas. This provides a strong but flexible panel over which is stretched the leather cloth. This is specially made for the purpose and differs from ordinary artificial leathers in that it is a two-ply or laminated fabric, bonded with a special oil cement, and the coating will retain its luster almost indefinitely.

A number of body builders are already producing fabric bodies on the Childs System and it is asserted that over 3000 jobs are now in course of construction. From the car owner's standpoint the principal advantages claimed for the fabric body are lighter weight with corresponding economy in operation, elimination of the drumming, rumbling noises due to vibration, and the ease with which it is cared for and repaired. To these may be added a lower first cost and a marked saving in insurance rates. It seems that the insurance companies consider the fabric body, because of its strength and flexibility, a safer risk than the wood or metal panel jobs, justifying lower rates.

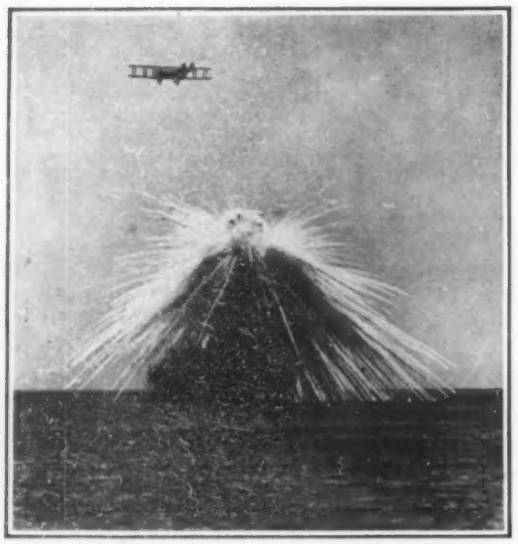


Left: First step in construction of the fabric body, a conventional wood frame being covered with coarse-mesh galvanized wire. *Center:* Appearance of the finished job—a custom-made fabric body on a standard chassis. *Right:* One layer of wire, two of wadding and one of canvas having been applied, the job is here shown ready for the application of the outer surface of leather cloth or other finishing material

Three stages in the manufacture of automobile bodies by a new process

Bombing the Battleship

Smoke Screens and Phosphorous Bombs Enable the Airman to Make Close-Up Attacks



A 100-pound phosphorous bomb hits fire-control platform of battleship. This phosphorous umbrella would make sighting of guns a problem

MILITARY history shows that men have ever sought to secure the high places. There has been more blood spilled for the possession of hill tops, ridges and towers than for any other objective. High points have been desired for observation and for positions on which to plant batteries. Aircraft have extended enormously the field of observation, and in the larger sizes they afford a movable and impregnable "battery," which can hurl a shell larger than any gun ever devised.

It does not take any flight of imagination to realize that the difference in shooting a bird on a limb and one flying is a matter of "leading" the target. Nor does it require technical knowledge to understand that, if an airplane is flying out of sight, it cannot be easily picked off by anti-aircraft fire. It takes the keenest eyes to see aircraft at elevations of over twelve or fifteen thousand feet. On the contrary, if he makes use of smoke screens and smoke bombs, a pilot can bomb with comparative immunity at *one thousand feet or less.* Much has been said about the value of tracer ammunition; but such ammunition is necessarily of different weight from ordinary ammunition and, since the burning up of the trail substance constantly diminishes the bullet's weight as it goes upward, it is bound to traverse a path different from that of ordinary ammunition. Using only tracer bullets would be a remedy for this fault; but difficulties of supply are encountered. During the war about one tracer bullet was allowed for each five regular bullets in aerial machine guns.

To say that a bomb will not sink a battleship is like saying "they can't put you in jail" when you are already in. It is natural for devotees of an old order to close their ears and eyes to any change. If, in the future, some means should be developed that would render airplanes helpless, there would probably be a few veterans of the air services who would repeat all the way to the ground in a tail spin, that it couldn't be done.

When steam supplanted sails after a long struggle there were hardy old sailors who persistently declared that it would not last long. The change from wooden to iron clad ships was made over a storm of naval pessimism that lasted for several years.

A bomb, whether laid in the water and exploding upon contact with a ship, or whether dropped from an airplane or shot from a gun if it has sufficient explosive will sink the ship.

There are aircraft that can carry a load of ten thousand pounds, but it is not necessary to drop any bomb of this weight in the vicinity of any battle fleet so far constructed. Bombs of six hundred pounds, or eleven hundred at the most, are sufficient to place a ship, even though she has steam up and her machinery running, out of commission.

The claim has been made that all the bombing tests conducted so far have been against ships that were anchored and helpless, and the inference has been drawn that, were the ships moving and defended, aerial attacks would be harmless. But this is begging the question. A battleship under steam, and carrying magazines of ammunition and a lot of delicate electrical equipment would be out of commission far more quickly than a so-called "dead" ship. The purpose of the bombing tests made so far has been merely to practice live bomb dropping and to discover the particular altitudes best suited for the particular bombs, etc. The tests in 1921 showed that armored ships can be sunk not only by bombs placed directly upon them but by bombs that fall in the water near them. The depth bomb has been fairly well developed. Be it remembered, also, that tests in 1921 were carried out successfully against a radio-controlled ship with as much ease as against an anchored one. It has been pointed out that the battleships used in the tests were obsolete. So were the airplanes. It is also significant that as many hits were scored upon towed or moving targets as upon those that were anchored.

The point has been made that the percentage of hits by bombers has been very small; but when this is said, *sinking shots* are meant. The large number of other shots that come close enough to a ship to disable her are ignored by the critics of bombing craft.

The speed of ships is not sufficient to enable them, without rare good luck, to escape a pattern salvo covering a considerable area, such as aircraft can drop around the target. It takes so long a time for a battleship to turn out of her course that bombs can fall from quite a height and still cover her. Even if a ship completes a turn of 90 degrees nothing is gained; for the pattern shots cannot be eluded. Zig-zagging to escape from aerial bombs is a useless maneuver.

Anti-aircraft gunners on this ship would have burning phosphorus fogging their gas-mask goggles and running down their backs

Dummy bombs drop differently from live bombs, and the personnel of the Army Air Service does not get much practice with live bombs. Hence, direct hits have not been quite so high on battleships as they will be.

During the 1923 bombing of the "New Jersey" and "Virginia," the larger bombs were not timed for the altitude at which the actual bombing was done, *i. e.*, 11,000 feet. It was estimated that some of the bombs went 200 feet beneath the water before exploding. The maneuver, however, was partly for the purpose of testing the functioning of the various bombs.

This 4000-pound bomb blasted a hole 50 feet wide and 20 feet deep. One hit would utterly disable or sink a battleship

Anti-Aircraft Guns Useless

Against a modern airplane with the pilot and the gasoline tank enclosed in armor, such ground fire as would reach the target would be deflected unless luckily placed. Tracer ammunition, as stated, does not work out very well, when shot upward, because of its deflection. Tracer bullets may make the same hole in a ground target at certain distances as regular bullets, but for air work their value is doubtful if not even detrimental, for their tail must swerve them as stated from the course followed by regular ammunition. Several aviators have stated, unofficially, that in order to demonstrate the case they would hazard anti-aircraft fire from a battleship, provided they were given the opportunity to drop bombs on her.

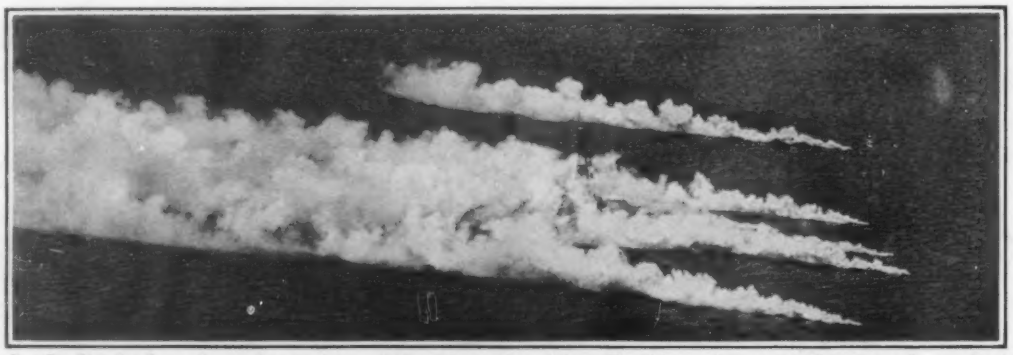
To hit an airplane in the air several unknown conditions are involved. If he is not using tracer ammunition, the ground gunner must know the speed of the airplane, its altitude, its distance, and the wind currents between. He has no way of determining any of these factors, and the spraying of a great quantity of bullets along the supposed path of the airplane is the only way of getting in even a chance hit. It is easy to see that an anti-aircraft gunner shooting from a rolling deck of a battleship would be at a great disadvantage, and the few seconds in which he would have to get in all of his shooting would lessen his chances of success.

In an attack upon battleships by airplanes, it might be expected that some airplanes would be destroyed. Even so, this would be economy; for battleships cost so much more than airplanes that several airplanes with their crews could be sacrificed in order to sink only one battleship costing thirty to forty millions of dollars and its crew of a thousand men. When a trench is taken it is usually expected that some losses will occur.

Such pictures as European countries publish in their journals showing bombing planes have significant characteristics. Note the egg-shaped nacelles. Note the nose of the American Barling Bomber. Such curved steel armor will afford very real protection to the personnel within these huge bodies. Airplane wings can be pretty well riddled without disastrous results. Big all-metal armored airplanes would withstand machine fire with something of the impunity of a battleship exposed to rifle fire. Moreover, airplanes flying at a hundred miles an hour and more stay under fire but a very short time.

It is frequently claimed that the only way to combat aircraft is with other aircraft; but when a battle-

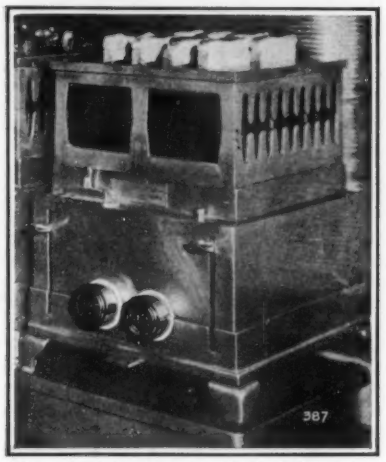
(*Continued on page 296*)



Smoke bombs have been dropped to windward of this ship. Bombing planes could swoop down, just above this smoke and drop their bombs with deadly accuracy

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



The electric toaster that takes the toast off the fire when it is done

Don't Burn Your Toast!

WHO has not burned toast? The electric toaster is the greatest offender in this matter, but the problem has been solved even for the housewife, if she can pay the price for an automatic toaster—of course a heavy duty toaster in a restaurant is no luxury, even if it does cost nearly two hundred dollars, for it will toast for 150 to 200 persons. It will supply 360 large slices or 500 small slices per hour with a current consumption of 5500 watts. While the toaster will make the little wheels spin around in the meter, we must remember there is no "Pompeiian toast" produced, as there would probably be with gas or the big restaurant range. Every slice is a rich golden brown. There is no watching or turning for when the toast is finished the racks raise it out of the oven and the current is shut off. This seeming marvel is accomplished by a timing device. It is impossible to leave the machine with the current turned on unless there is bread in the racks.

The Safety-First Industrial Shoe

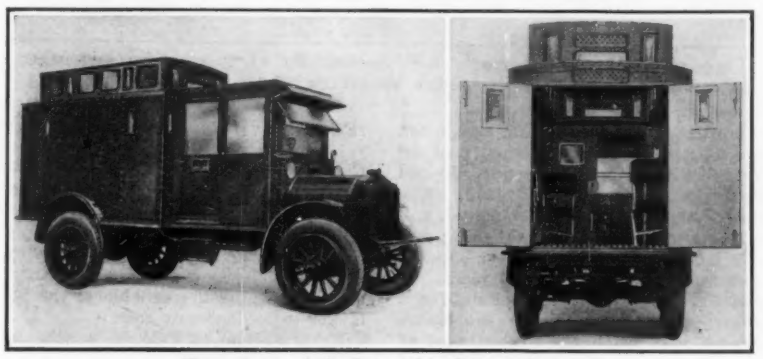
ONE of the chief causes of work accidents is shoes that cannot be quickly removed. Railroad men cling to the old-style congress shoe because, if a man accidentally gets his foot wedged in a track frog it is possible to get out of the shoe in a hurry, losing the shoe but saving the foot. But some men do not like to wear the old-fashioned congress shoe because it looks "antiquated." They wear the regular laced shoe, and then if they happen to get a foot caught in machinery they often lose the foot because there is not enough time to unlace the shoe.

Realizing this fact, therefore, a Boston manufacturer of shoes has found a way to combine the get-out-of-it-quick quality with a resemblance to one modern type of footwear. This is made possible by the adoption of glove snaps. These snaps, are, however, extremely large and rugged, for they are designed to hold fast until the wearer wishes to remove the shoe. Then all that is required is to seize the top of the shoe-flap and give it a strong tug, after which the imperiled foot is quickly and safely withdrawn.

The shoe that can be shed in an emergency without stopping to unlace it

Security for the Payroll

THE body of the armored car here shown is of armored plates inside and out, mounted on steel framework, and with a packing of dense felt between. The ventilators are protected on the inside with spring covers to offset the possible use of gas or tear bombs, and are of bullet-proof glass. The ports are so placed that the occupants of the car can get a range on attackers from any angle, and at two different levels. The port covers are so arranged that they open automatically to the pressure of a gun-barrel from inside, and close under spring pressure as the gun is withdrawn. The two sections of the windshield overlap along their junction line. The rear compartment is separated from the driver's seat by a partition equipped with a sliding door, furnishing complete protection to guards even though the driver be overpowered. The body envelops the mudguards in such a way that there is no possibility of riding outside; and with the same end in view, the front step folds up into vertical position when the door is closed. The rear compartment is equipped with an emergency lever that releases the clutch and applies the brakes; so the car can be stopped, and its further operation from the seat made impossible, by the guards within. The body plates are welded at the corners, so that even should the car be overturned, the occupants would be safe. On the whole, this is about the best thought-out car of the sort that we have seen in connection with the increased interest in them brought about by the increased vogue of payroll holdups.



Two views of the latest bandit-proof car

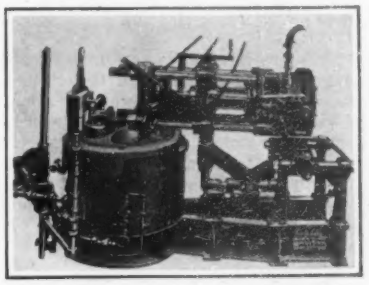
Casting Small Parts by Machine

MANY small parts of the automobile, adding machine, typewriter, phonograph, and other mechanical contrivances are now made by the die-casting process instead of the old machining method formerly used. The die-casting industry which has been developed in the United States in the last 20 years represents one of the greatest labor-saving processes used in mechanical production.

Die-castings are made of alloys having a base of either zinc, tin, lead, or aluminum, and running as high as 35,000 pounds per square inch in tensile strength. The castings are made in steel molds under varying pressures running as high as 400 pounds per square inch and are taken from the die cast accurately, to .001 inch, with smooth and uniform surfaces.

The machine which will supply this demand must be simple to operate, fool proof, and capable of high production. A machine of this type has been developed during the last five years by E. N. Dollin of New York, and a number of these machines are in operation both here and in England. Practically any intelligent workman can operate them as they are fool proof and absolutely safe. A great advantage is that they are interchangeable as to alloys; they will cast aluminum with high efficiency and may be changed over to the zinc, tin, and lead alloys with equal efficiency. They relieve the operator of all the hard manual work, opening and closing the dies and shooting the metal entirely by power. In addition they have ample power to pull cores and slides. The machines are sturdy and strong in design and are operated by two valves.

The method of heat regulation has been improved, making it absolutely reliable, and the alloys are handled in such a manner that deterioration by heat and absorption of iron is reduced to a minimum. The up-keep is low, and they use very little power, a new patented method of using compressed air being employed.



Die-casting machine for the rapid production of small metal parts without machining

The Mullen Tester for Measuring the Quality of Paper

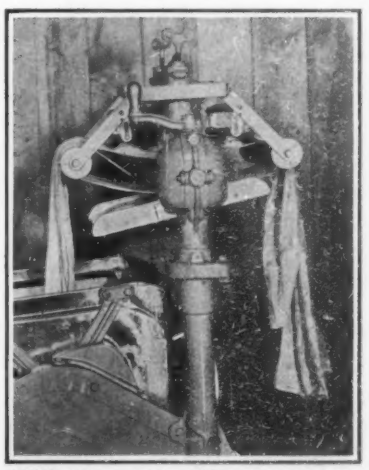
WHAT is known as the Mullen tester is used almost universally in this country for determining the bursting strength of paper, and on this factor is based to a large extent the measure of the quality of the paper. It often happens, however, that a sheet may be so made or so sized as to have a very high bursting strength and yet show up very poorly in a tearing or folding test.

The Bureau of Standards is working on a supplementary test employing two steel rollers which produce a crease in the paper under controlled conditions of pressure and time. The bursting strength is determined before and after such folding. The loss of strength under these conditions is an excellent indication of the brittleness of the paper. The method, however, must still be standardized.

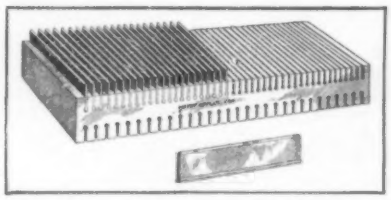
The Safety Wringer

ELECTRIC wringers are very wonderful conservators of elbow grease; but there is one disadvantage which they have always possessed. When one is grinding away at a hand crank, one can, and will, stop instantly at the slightest suggestion that the clothes are getting tangled, or that any portion of one's anatomy is about to accompany them between the rollers. With the electric machine, it is not possible to make such an abrupt stop; by the time the danger has been noticed, the switch thrown, and the impetus of the motor exhausted, the damage has probably been accomplished.

There have doubtless been numerous guards designed for the electric wringer to prevent this; but we believe the one we illustrate herewith, the invention of W. S. Osgood of Chicago, is distinctly novel. The device consists of two idle rollers carrying an endless canvas belt. The rollers are placed, one before and one behind the business rollers of the wringer; and the upper turn of the belt passes between these, while the lower turn comes back between the lower roller and the drainboard. The belt carries the clothes between the wringer rollers in a continuous stream; they are fed on to it rather than into the jaw of the wringer. They adhere to the belt just as they adhere to one another under the wringer pressure; and since the



With this guard, neither fingers nor clothes can go astray between the rollers of the electric wringer



Novel assembly of printers' rules that saves much time on large jobs

belt cannot possibly wrap around the wringer roller, neither can the clothes. And no part of the operator's anatomy can get close enough to the rollers to be carried between them; so that fingers are quite as safe as the clothes themselves. The guard can be attached to any wringer by turning two screws, and once on may be left permanently in place.

One Brush for the Whole Typewriter

SOMETHING new in the way of typewriter-cleaning brushes is offered by a New York dealer. Its three-in-one construction does away with the separate use of the three brushes that have heretofore been necessary to get at all parts of the machine that require cleaning. The big fellow at the right end is a soft brush for the general work of cleaning between the keys or the type rods, under the carriage, etc. The round affair mounted on the shaft at the left of the handle is a rotary brush which, it is claimed, really cleans the keys; and the handle is designed with a special view to making it easy to spin the thing by hand as the brush in question lies on the face of the type. And the long, lean brush at the extreme left goes into all the hard-to-get-at places and brings the dirt out with it. Finally, the maker drops the very foxy suggestion that there are lots of things besides typewriters in the average office that would be kept cleaner if there were a better way to clean them, and that this brush will be applicable to them.

Time for the Automobilist

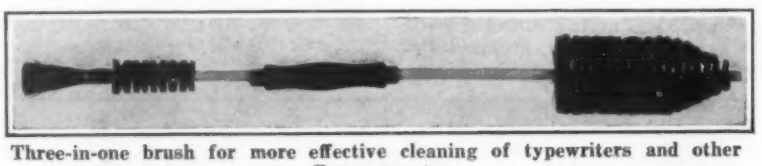
SOME cars are manufactured with a clock on the instrument board, or at least with a place for one; others do not thus provide for the comfort of the driver who wants to know the time. For use with those that do not, the stiff wire rack which we illustrate affords a very handy attachment. It is easily screwed to the board by means of the metal base-plate, as shown; and the watch from the driver's pocket, or one permanently devoted to use with the car, is very easily fitted into the loop of the wire, where it is held securely and with its face in plain view. The wire, while heavy enough to hold its burden in safety, is of such character that the loop can be squeezed down smaller or opened out larger to accommodate a watch of any size. It is of steel, covered with woven linen thread;

For the car that makes no provision for a clock

and its shock-absorbing arms protect the watch from injury. Incidentally, the watch is held in such position that all the passengers, as well as the chauffeur, can read it.

A New Way of Setting Ruled Jobs

FOR the job-printer who has enough rule-setting to justify a little initial expense, there is now offered a most efficient scheme for cutting down the costs of this particular type of composition. Slotted bases of the sort illustrated, with rules to fit the slots tightly enough but not too tightly, are the foundation of the new idea. The hole at the bottom of the slot, with the flange at the bottom of the slides, prevent any catastrophe to the form after it is once arranged. The idea is to use, singly or in combination, such of the bases as give the necessary length of rule; and, for vertical rulings, to set ordinary foundry rules between the bases at the desired points. Where no vertical rule is wanted, the bases may be fitted together flush; and it is then contemplated that single slides be used, of sufficient length to span both (or all, if more than two) bases, locking them together very nicely. By setting rules in every slot, every alternate slot, etc., etc., each base is made to serve a wide range of duty. In fact, two separate models for the base, each having a different measure between the slots on either face, are sufficient for all the standard rule measures; and when each base is provided



Three-in-one brush for more effective cleaning of typewriters and other office apparatus

in ten different widths, from one to ten picas, it is possible to make them up into combinations giving any desired width in steps of a half-inch. The rules themselves, it is contemplated, will be made up by the individual user; and he is advised to have these on hand in all lengths from one to 36 picas. It need hardly be pointed out that, for a given face of rule, the same slides can be used with all bases. In support of the claims made for the new way of setting ruled matter, a job is cited which took nearly an hour with the conventional rules and slugs, and less than ten minutes with this apparatus.

Salts Cause Rapid Decay of Building Stone

SEVERAL cases of stone decay in new buildings were found in the course of an inspection of two hundred stone buildings recently conducted by the Bureau of Standards. The cause of this early decay appeared to be principally due to a recrystallization of soluble materials which had been leached out of the mass of the stonework or the mortar, and had deposited as an efflorescence in certain places at the surface of the stone or slightly beneath it. This phenomenon occurs frequently under the water table or under the cornice. It has been noted in structures of different types of stone, but most often in those of sandstone.

The same effect has been duplicated in the laboratory by placing blocks of stone partly immersed in a weak solution of sodium sulfate. The salt is carried up in solution through the pores of the stone by capillarity and deposited as crystals on or slightly beneath the surface wherever evaporation occurs. The expansion of the crystal causes disintegration of the stone in a manner similar to that of frost, but the process is much more rapid.

Fresh Cigars from Every Box

THERE'S something in this box of cigars besides the smokes. Look closely, and you will observe, in the right end, what might be almost anything, from a bomb to—well, to a tiny humidor, which is exactly what it is. Carried thus in the cigar box, it enables the fastidious smoker to have his cigars in just the same condition, on the train or in the automobile, as in his study at home. So popular has the idea turned out to be, that an eastern department store which offered one of these tiny humidors with every box of cigars had to reorder the humidors on a large scale, and has found a good sale for them, separately, since the special offer expired.

A New Discovery of Radium

FERGHANA, in Russian Turkestan, is the source of the newest supply of radium. Pitchblend, from which radium is reduced, was for a time largely brought from Colorado. Later discoveries of richer ore in the Belgian Congo have resulted in forcing some of the American developments out of business. Now it is claimed that the Turkestan pitchblend is much richer than that from the Congo and efforts are being made to develop the new find at once for use in hospitals. Our supply of radium is so limited that all that is recovered in the world could be placed in the palm of one hand—if one did not value the hand. In America, radium is available in the larger centers, yet it is stated that not five per cent of the people who need treatment with radium can make use of it because there is not enough to go around. A group of four unnamed American philanthropists have united for the purpose of securing, if possible, the new supply from Turkestan and making it available to the public for medical use at cost.

Much radium is used on watch dials and for other luminous objects such as pendants for locating electric lights in the dark. This radium is usually in the form of radioactive barium sulfate and its luminescence lasts only three or four years. After that it is for all practical purposes lost, since few individuals would find a way to return so small amount to any central source of supply. A full pound of radium would be worth about $50,000,000.

Judging the Fertility of a Soil

HOW to judge the condition of the soil of a farm or garden without planting a crop on it, and then waiting to see whether it is a success or a failure, is a perennial question in agriculture. According to *Soil Science*, one way of arriving at an opinion in any given case is to take a census of the bacteria, microbes, and other infinitesimal organisms living in the soil in question.

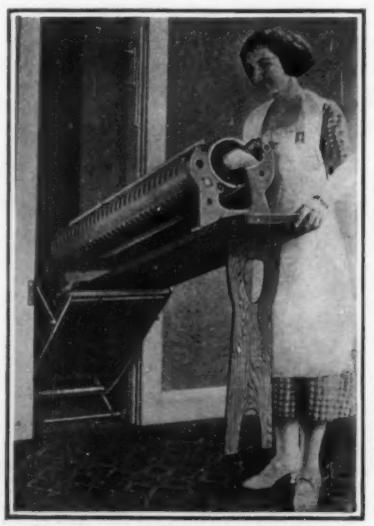
Counting the bacterial population of a 160-acre farm may seem a large order, but in practice it is no more difficult than to take a representative sample of the soil and have it tested by a bacteriologist, who will weigh out a small portion of the sample and mix it with a broth which microbes like. Each microbe starts to raise a family or colony in its new surroundings, and when these colonies become large enough to be visible, they are counted; after that it is only a matter of arithmetic to arrive at a figure representing the bacterial population of the whole farm.

Like all other living beings, bacteria thrive best where food is most abundant, so that where a soil is found to be rich in these small organisms it is clear that the soil must also be rich in food elements. Crop production has been found to be almost parallel with the number of microorganisms which the bacteriologists have counted in the soils, so the method of judging fertility by a bacterial count can be regarded as fairly reliable.

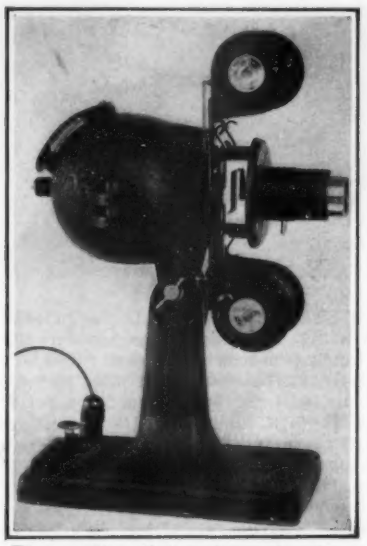
Miniature humidor for the cigar box or suit case

A Laundry in a Closet

THIS caption is only half correct. Perhaps it would be more truthful to say an "ironer" in a closet, but after all ironing is half the battle for the "wet wash," if you send it out, has to be ironed unless the laundry does all the work. There are many housewives who have electric washers which do the work so quickly that Monday is not as blue as it was formerly, but how about Tuesday with the dreaded ironing? Of course the electric iron has robbed Tuesday of its terrors, but still there is manual labor to be performed often in summer under exhausting conditions. We went to a recent show of household appliances and we saw an ironer which was so interesting that we decided to illustrate it. This was a complete ironer that disappeared in the wall or into the closet yet was ready at an instant's notice. It ran with any kind of current on 110 or 220 direct or on alternating current 25, 50 or 60 cycles. It was heated by gas, gasoline or gasoline gas, or nicest of all, electricity. One hour on this machine produces as much as five hours by hand and the workmanship is irreproachable. The cost for a week's ironing is about 26 cents a week against one-half of the laundresses $4.10 per diem in our locality.



The disappearing electric ironer



The machine that replaces the glass stereopticon slides with a strip of standard motion-picture film

Film Practice for the Stereopticon Lecture

THERE is now offered a miniature still-picture projector which uses small strips of standard motion-picture films, each strip containing from 50 to 300 separate views. A specially designed resistance cord eliminates the rheostat, and enables the machine to be used from any light connection. It uses a small standard incandescent lamp, readily replaceable from any electric or automobile supply store. The whole apparatus, together with several thousand pictures, can be put in the drawer of a desk or in the bottom of a small hand grip. It will project at any distance from 30 inches to 30 feet. An insulating device protects the film from the heat of the lamp, so that a single picture may remain upon the screen for hours, if need be. This makes it possible to hold a picture on the screen for protracted analysis or discussion. The film will move backward or forward, so that pictures far back or far ahead in the series may be instantly referred to. The convenience of carrying a small, compact film roll instead of a large number of bulky and heavy glass slides need not be dilated upon.

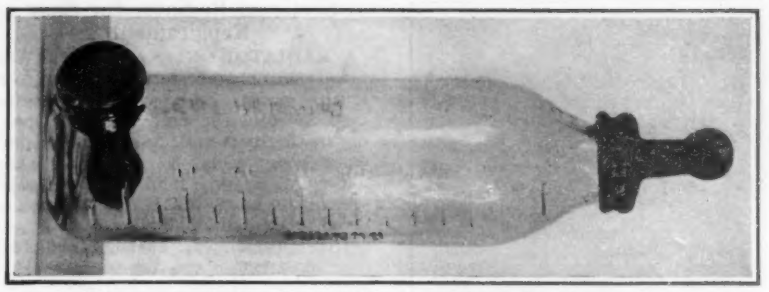
The new machine is designed to take the place of the stereopticon. Where now the pictures which are to be used are made up into a series of separate glass slides, using this machine they will be laid down, one after another, on the successive frames of an ordinary film strip. The instant availability of any picture in the series, the rapidity with which change can be made from one picture to another, or a series of several displayed, and the elimination of fire hazard, are conspicuous among the advantages gained — not to mention the greater ease of manufacture of films over glass, the increased convenience of transport, and freedom from breakage.

Better Nursing-Bottle Practice

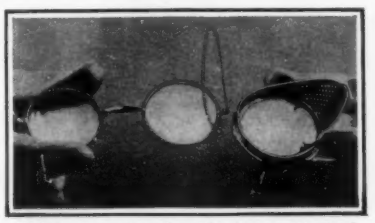
BABY awakes in the middle of the night wailing; and on investigation, daddy discovers that baby didn't get all his dinner. Something went wrong with the nipple, and half the latest meal is still in the bottle. Mr. C. C. Campus, of New York, has analyzed this familiar situation, and decided what lies at its root. He points out that when the infant sucks milk through the nipple, air must enter the bottle, from somewhere, to take the place of the milk—or the milk can't leave. In the conventional nipple, this air has to leak in through the same hole that the milk comes out of. Two-way traffic on a single-track road is no more impracticable than this.

So Mr. Campus has designed a new nursing bottle which he offers for the delight of all mothers and all babies. At the lower end, as illustrated, he pierces the glass with a large hole; and around this hole he erects a circular shoulder of glass. Then it is simple to turn a regular nipple inside out and hang it over this shoulder, so that it projects within the bottle. The hole in this nipple is smaller, even, than that through which the baby is accustomed to getting his milk; and the exposed inside of the nipple is filled with clean cotton. The net result is that no milk leaks out, but with every pull that baby gives on the regular nipple, air leaks in. The advantages are not restricted to the smooth, regular feeding which the bottle is primarily aimed to provide, but include numerous other items.

The air doesn't pass through the milk at all, but goes direct from its entrance valve to the air-space in the bottle—study the position of the nipple with reference to the milk when the bottle is tipped if you don't believe it. Mr. Campus believes that, even if the cotton had no filtering effect, this would preserve the milk a good deal better from the action of germs in the incoming air; and he points out that there is less cooling action by the air on the milk. Certainly there are less air-bubbles in the milk. Then, when it is time to wash the bottle, both nipples are removed and a clear flow of water through the bottle is achieved—something quite different from the usual procedure for cleaning the usual bottle.



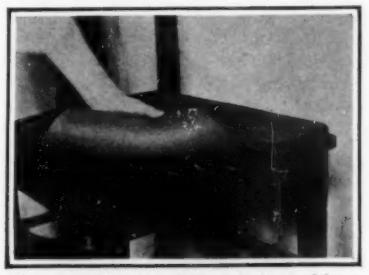
The nursing bottle that is better for baby and easier to clean



Safety goggles for the be-spectacled worker

A Different Chair Cushion

THIS rubber chair cushion is manufactured under a process which results in the rubber's acquiring the porous character of a sponge, so that the pores permit ventilation as well as insuring coolness and comfort. The cushions thus made are about five-eighths inch thick, and shaped to fit the average chair seat. They will not slip or slide over the polished surface of the latter, the rubber surfaces tending to hold them in one place on the seat of the chair.



The ventilated-rubber chair-cushion

Combining Safety Goggles with Spectacles

NOT only workers in the industries, but a very large number of people at work and at play find difficulty in getting goggles that may be worn over common spectacles without discomfort. Recognizing this fact, a Reading, Pa., manufacturer of goggles has placed on the market a special goggle for wear over the spectacles. These goggles are made up in a new form, the parts for either side being entirely separate. A simple spring clip attached to the inside of the cups enables them to be attached to the spectacles in a moment, where they hold fast "like a bulldog to a root." The workman who clips this goggle to his spectacles is prepared for the eye hazards of his work. When his day's work is through he removes it as easily as he attached it. Taking human nature into account, it is the extreme facility with which it may be attached, and the freedom from annoying slipping and looseness which may accompany the wearing of some goggles, especially when worn over glasses, that results in workmen omitting them "just for this time" and getting injured. The new style of goggle is most attractive in appearance and it is made up entirely of metal so that it may be cleaned by scalding. It is made to clip over a 1 9/16-inch standardized round industrial spectacle. Factories which see to it that those of their employees who must wear spectacles do not go without proper safety goggle protection will find in this device an opportunity to save on workman's compensation. The "goggles" are so neat that there would be no excuse for the men's not wearing them.

The Motion Display Sign

A LARGE motion display sign, 43 feet long by 12½ feet high, showing three different pictorial displays at intervals of 10 seconds, was recently placed in service on a prominent corner location in Kansas City. The sign is composed of a series of ten triangular metal drums, each drum 3½ feet wide by 10 feet high, with the changing display face 34 feet long by 10 feet high inside the border of the sign. The drums are pivoted, top and bottom, on ball bearings, and are revolved in unison from one display position to another by an automatic mechanism housed in a dust-proof case 18 inches square half filled with lubricating oil. The framework of the sign is light structural steel forms, and the pictorial displays are painted across the entire 10 drums when alined in position. As the drums are identical in construction, even larger signs may be built by adding more drums or increasing their height, as desired. Heavy rains and wind have shown this sign to be unaffected by weather.

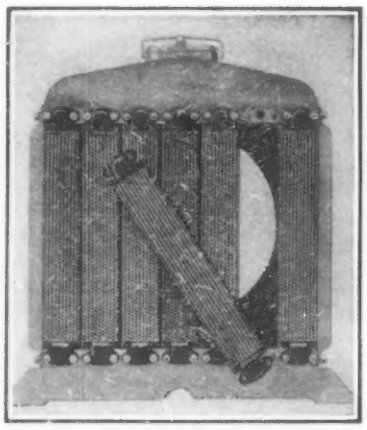
The sign is operated by a small electric motor, and is controlled by two 10-day time clocks which start the motor at 6:30 a. m., switch on the lights at dusk, and stop both sign and lights at midnight, always with some one of the three display faces in alinement. At night the lights in the end post brackets change color with each display, so that besides presenting a continuous moving picture outdoors during the day, the variety of color at night is especially attractive.

The three-way advertising sign, caught in the act of making a shift

The Thermos-Bottle Washing Machine

A HEAT-RETAINING tub, built on the principle of the well-known "Thermos" bottle, is the outstanding feature of a new electric washing machine. How to retain the heat in the wash-water in the washing machine has long been a problem to the housewife, for it is declared that auxiliary heating attachments are very often unsatisfactory and troublesome and in time tend to "yellow" the white clothes. The tub of this machine is a double tub, built of copper and cypress. Between the outer tub of one-inch cypress and the inner tub of tinned copper is a vacuum and this "dead" space at the sides and underneath provides an insulation that is said to make the loss of heat practically impossible. Other features of the machine are the perforated aluminum

Washing machine with vacuum space around the tub to prevent loss of heat



Unit construction of radiator, aimed at rapid replacement of a damaged tube

wings which swirl hot suds through the clothes at approximately one hundred times a minute; the aluminum wringer which swings completely around and has four fixed positions in which it can be securely held by a self-locking catch; and the adjustable legs which may be raised or lowered as the housewife desires.

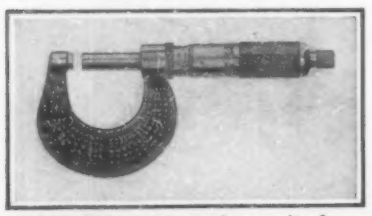
Quick-and-Easy Egg Separation

SEPARATING white and yolk of an egg is an old kitchen trick, but not such a simple one that a tool to facilitate it will be scorned by the housewife. A spoon with a slotted bowl is the answer. If an egg is dropped into this, the white runs through the slots while the yolk remains behind in the bowl (of the spoon). The spoon with the slots can be used for many other purposes as well. Potatoes are creamed with it, cake beaten, and on the end of its handle is a bottle-cap remover.

Decimals and Sixty-Fourths with a Single Micrometer

THE machine operator in many shops finds himself between the frying pan of the metric system and the fire of the half-quarter-eighth, etc., system of fractionating the inch. He gets some jobs that call for the one style of measurement and some that call for the other. He has been in the habit of meeting the situation by using two micrometers, or by using one micrometer with a card carrying a table of decimal equivalents. Now a New England manufacturer has conceived the bright idea of putting this table on the frame of the micrometer itself.

On one side are the decimal equivalents of eighths, sixteenths and thirty-seconds; on the other, those of the odd sixty-fourths. The figures are raised on the frame rather than stamped in it, so that they do not fill with dirt, and at the same time give better grip on the tool for oily or greasy work. And the tool itself embodies all the standard refinements of micrometer practice, in addition to the new one. For the present, the micrometer with decimal equivalents is supplied only in the one-inch size, but we should judge that demand will call for an extension of the line.



This micrometer carries on its bow the conversion table from 64ths to thousandths

Sectional Radiator for Easy Replacement

A RADIATOR developed by a Wisconsin manufacturer for use on trucks, or any type of gasoline engine used for construction work is interesting in that it is built in sections so that damaged units may be replaced with the minimum of time and expense. The special form of the core construction gives exceptionally great cooling capacity, it is claimed. Through this spiral core construction and the presence of a copper strip in each air cell centrifugal action on a column of air is produced during its passage through the radiator. Extra large water channels allow for a constant flow of free water with the minimum of danger from clogging or freezing. And when clogging or freezing do occur, repairs are made with a minimum of cost and a minimum time of lay-up for the truck.

Slotted spoon for separating eggs

Steering with a Screw-Shaped Cam

SOMETHING distinctly new and decidedly interesting in steering gear is being introduced by a tool company of Lafayette, Ind. It is called by the manufacturers a cam-and-lever gear; though, without any desire to quarrel with them, we think a name more descriptive of the action of the prime member might have been found. This member is, in fact, more like a variable-pitch screw than a cam; the only apparent reason for calling it a cam is that a lever bears in it, and takes motion from it in a fashion that is in some slight way suggestive of cam action.

The screw member in question is at the lower end of the steering tube, and when the wheel turns, it turns with it. The diamond stud projection on the inner side of the lever, which engages with the "cam," then travels up or down, according to the direction of cam rotation. This rotates the lever, and through it the trunnion shaft and the steering arm.

In mid position, the pitch of the cam is very slight and the motion of the front wheels slow; but as the pitch increases toward either end of the cam, the response of the wheels speeds up. In straight-ahead driving, the very low reduction of the gear in mid-position eliminates practically all road shock. In making an actual turn, the further the steering wheel goes around, the faster the steering response, so that nothing like the wide swing of the wheel is needed here as on conventional worm steering gears. The lever arm inside the gear is very long, giving high leverage combined with claims of easy steering and long life.

An Ammeter for Heat

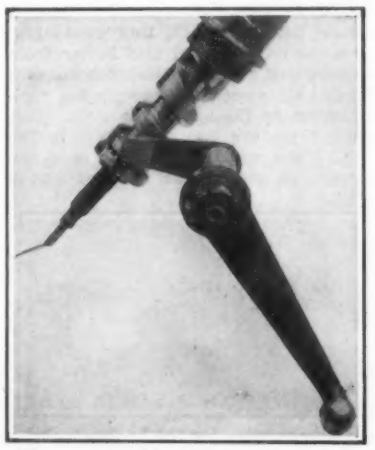
IF an electrical engineer wanted to measure the resistance to electric current of a complicated piece of electrical apparatus, or of several of its parts which were connected in series, the easiest way to do it would be to measure with an ammeter the current flowing through the apparatus and then measure the voltage drop across the apparatus or across each part. From these the resistance can be calculated.

When the Bureau of Standards undertook to make measurements of the resistance offered to the flow of heat by different types of wall construction an apparatus somewhat similar in principle was devised. The amount of heat flowing through a wall panel is measured by a "conductimeter," which in itself offers little resistance to the flow of heat, and then the temperature drops through the wall and through any desired portions of it are measured.

The tests thus outlined are made on panels built for the purpose, these panels being about three feet wide and six feet high. Thermocouples are attached to their inner and outer surfaces and are also built into the wall in various positions throughout its thickness. Other thermocouples measure the temperature of the air in the "house" and of the cold air "outside."

The conductimeter itself consists of a panel of wood three-fourths of an inch thick and eight inches square. Thermocouples are distributed over its surface by which the difference in temperature of the two sides can be measured. This is surrounded by a much larger wooden panel of the same thickness which is separated from the central panel by a small air gap. The purpose of the outer panel is to insure a parallel flow of heat through the conductimeter and the wall behind it, and to do away with the edge effect which would otherwise have to be considered.

The wall panel under test is placed between two boxes which are lined with cork on all sides except the one against



The cam-and-lever steering gear, showing the lever in extreme position at the lower end of the screw-like cam

the panel, which is open. One of these represents the inside of the house, and is heated by means of electric heating coils; the other represents the outside and is cooled by a refrigerating machine. The cold box and the room in which the apparatus is set up are kept at constant temperature by means of thermostats. The warm box is heated by current from a storage battery, which is so adjusted as to keep the proper temperature in the box. Temperatures are recorded continuously throughout the test.

With this apparatus tests on various types of walls are being undertaken. Panels already made up for testing represent frame construction with wooden siding, frame with stucco, brick with furring and brick without, hollow tile, with cells vertical and with cells horizontal, and concrete block. This technique for measuring heat conductivity and heat insulation is of extreme potential value to the building industry.

Electric iron with a soapstone body for storing heat

New Iron Stores Heat in Soapstone

AFTER about seven minutes of heating, the plug connection for this electric iron may be removed. The heat stored in the iron-shaped piece of soapstone, will do the ironing for a period of 12 to 45 minutes. Its advantages are many, one of which is that a new soapstone can be replaced easily by the owner of the iron. It is not necessary to send it to a repair shop. It is practically scorchless, and will not become overheated through carelessness.

Production of Solid Hydrogen

IN connection with its study of materials at low temperatures, the cryogenic laboratory of the Bureau of Standards produced on February 21 about one liter of liquid hydrogen, part of which was later frozen into approximately 100 cc. of frozen hydrogen. The temperature of this hydrogen "ice" was estimated to be about 437 degrees below zero Fahrenheit. This is the first time that solid hydrogen has been produced at the Bureau. Great difficulty is experienced in liquefying this lightest of all gases, because any impurities in the hydrogen, such as air, freeze solid before the hydrogen liquefies, clogging the apparatus. Using a special multiple wall vacuum container, designed by Dr. C. W. Kanolt in charge of the low temperature work, it has been found possible to preserve liquid hydrogen for a much longer period than with the older forms.

The Sparkless Gas-Hose

THE accompanying photo shows a nozzle that has been especially designed for the purpose of eliminating the possibility of a spark's starting a fire when such refined oils as gasoline are being delivered from tank wagon to steel drums. The new nozzle is tightly held in the opening in the steel drum, so that it is impossible to strike a spark. There is a spring, which is pressed inward when the nozzle is to be inserted into the opening of the drum. When released the spring holds the nozzle rigidly within the opening. The operator can then attend to other matters, without danger of the nozzle being jerked from the opening, causing a waste of oil.

Establishing firm contact between hose and tank prevents the passing of sparks

Two views of a new stock-and-bushing assembly for threading the ends of pipes

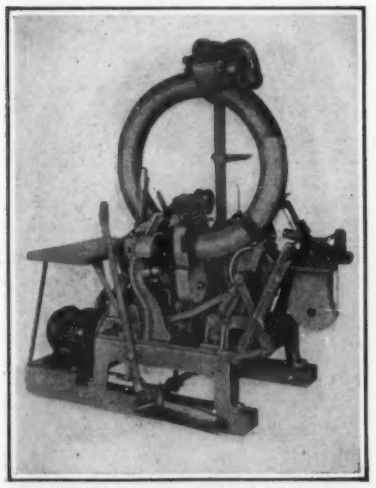
Rapid-Fire Pipe Threading

ONE tool for cutting external screw threads on the ends of pipe of various diameters is now offered in an invention by James L. Lesslie, of Boston. The invention comprises a stock formed to receive and rotate any one of a quantity of interchangeable thread-cutting dies about a fixed pipe-end, as well as to hold this die coaxially with the pipe. In addition there is a bushing located at one side of the stock, and intended to be supported by the pipe itself during the cutting operation. This bushing then provides an elongated bearing of the appliance upon the pipe. Our upper view shows the stock, die and bushing disassembled, so far as is necessary to show their forms and relations, while the lower picture represents them in readiness for work. It may not be entirely superfluous to remark that the pipe that is to be threaded does not appear in either picture, the short pipe-lengths that do appear being merely the handles of the stock. It will be observed how the bushing is supported in offset position so that its hole falls in line with the cutting die.

How the Paper Tape Gets Around the Tire

JUST before shipping tires a strip of paper is wrapped around them by an interesting machine and the time required for applying the paper and an advertising gummed tape is about ten seconds. The shuttle or head of the machine is ring-shaped and is opened by means of a hinged gate. When the tire is inserted and the gate closed a lever is pressed forward for compressing the beads so as to make a tight wrapping which prevents the slipping of the paper covering.

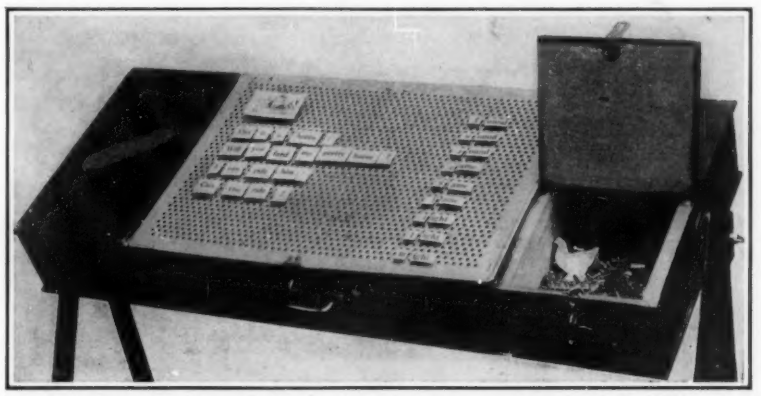
The clutch which engages the motor is made operative by means of pressing either the lever at the left of the machine or by stepping on a foot pedal. This brings the tire drums or sheaves into action, causing them to revolve at the proper speed, so that the pitch or advance is commensurate with the revolving shuttle.



Ten seconds per tire is the speed of this wrapping machine

Making a Game of the Tiny Tot's Education

FORMERLY a teacher and now a mother of three children, Mrs. Verna Watkins of Atlanta has invented an educational toy which has the hearty endorsement of many teachers and authorities on child development. The desk illustrated is designed primarily for school use, going from the kindergarten through the fourth grade. Its broad principle is simple enough; the perforated desk-top combines with the shanks on the "pieces" to enable the child to set up, more readily and in much more stable form than would otherwise be possible, the letters, words, or designs to which the pieces lead. It is in the flexibility of the last remark that the value of the device lies. Obviously words and numbers for reading and arithmetic lessons are the most elementary application. But the only limit lies in the ingenuity of the teacher or the parent. Everything from maps to an elaborate set up of barn-yard scenery falls within the range of "Peggy," the very suggestive name adopted for the apparatus with its peg bottomed auxiliaries. It makes every lesson a game, and every game a lesson, and its inventor is confident that it will have a very wide application in the school, the home, the hospital, the Pullman car—wherever it is desired to keep children happily occupied.



The hole-topped table and the peg-bottomed pieces with which the little chap is cajoled into educating himself

Fog Alarms Operated by a Human Hair

AMONG the many automatic devices which stand between human life and death, the "fog valve" is about to take its place. This recently invented control enjoys a position unique among safeguards of life, in that it depends for its successful operation upon several strands of human hair.

When a caller comes to your door, you want the bell to ring. But wouldn't it be a nuisance if the bell rang continually? This, in a nutshell, was the problem faced prior to the invention of the fog valve, in coping with the dangerous fogs which from time to time invade our coasts, and make navigation particularly dangerous.

Under the old system, fog bells and whistles were kept continually on many unattended lighthouses and buoys. While necessary, this practice had two very distinct disadvantages. The first was, of course, the additional expense of having this machinery operating 24 hours a day, when frequently there was no need for it. The second was that in places where the buoys or lighthouses were placed in close proximity to towns, the continual sounding of fog signals was annoying to those within hearing distance.

A way has now been found to make the dreaded fog sound a warning against itself. Several strands of human hair are stretched across a wooden frame. Each hair is about 17 inches long, and at each end is attached to very sensitive springs. As the fog comes rolling in on the coast, and the atmosphere reaches a point approximating 95 degrees of humidity, the strands of hair expand. This elongation, though slight, is sufficient to set in operation automatic fog bells, whistles and sirens. As long as the fog remains, the hairs stay expanded, and the signals continue to warn mariners of dangerous rocks and reefs which cannot be seen.

As the fog recedes, the hair-strands slowly dry out. This action takes about an hour and a half. At the end of this time the hairs have dried, contracted, closed the valve, and the signals are shut off.

While it is possible to operate the device with any kind of human hair, Mr. Hingsburg explains that hair from Chinese queues is being used in their manufacture. This is because it is uniformly long, tough, and black. Another important factor in favor of the use of the Chinese hair, is that unlike the hair of another race, it is round, not oval. This aids in uniform expansion. The hair is first treated by a special process to remove all grease or other covering which might make it less sensitive to the action of moisture.

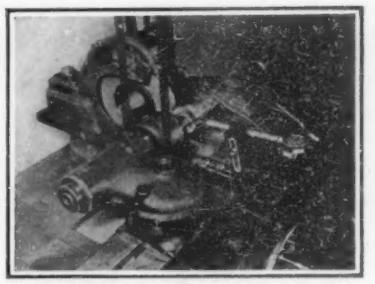
Already three of the valves have been placed in operation, one being at Lambert's Point, Norfolk. No publicity has been given this installation of automatic controls by the Government Lighthouse Service, and many people in the vicinity of the three now in operation believe that the signals are being turned on and off as need arises, by human hands. The utmost confidence is placed in the new invention by officials of the Lighthouse Service. It is really an adaption of a device employed in the British airplane service, and described in these columns several years ago.

A Combination Chain Bolt and Alarm

THE old chain bolt for apartment or house door protection has been considerably improved.

Here is a combination chain bolt and alarm bell. As illustrated, the door may be left open for ventilation purposes on a warm day. If pressure is used on the outside it will start ringing the miniature Big Ben which is a part of the combination.

Bell is wound by turning by hand, after the chain is secured as shown. If the bolt is placed in the hole opposite where it is now located, it supplies an alarm and protection when the door is fully closed.



Indicator that gages cylindrical work while it is in motion

Gaging on the Fly

DESIGNED for use in gaging cylindrical work while it is being rotated a new indicating device has been developed by an Ohio manufacturer. The device requires only a few seconds to adjust and by means of a clamping screw in the base it can be swiveled in either direction. The connecting link with which the device is slotted makes it convenient for the operator to set the gaging pin at any angle. The dial is connected with the gaging pin which rests against the work and registers the job measurement in thousandths.

An Unbreakable Cigar

PROFESSORS James S. Long and Henry Ullman, of the Chemistry Department of Lehigh University, Bethlehem, Pennsylvania, after a year of research work have successfully discovered a method of treating cigars so that they will not break in the pocket.

They concentrated their attention on the binder of the cigar, which is its strength. It was found that tobacco stems which are left over after the tobacco leaf is stripped, and which have been considered as refuse, would make a very tough paper-like material, resembling a tobacco leaf when rolled out on a paper pulp machine.

To preserve its odor a liquid which was pressed from tobacco leaves was mixed with it when it was rolled out. This made a very desirable binder; but when smoked, it gave an odor like that from burnt paper. The problem was how were the chemists to restore the tobacco odor.

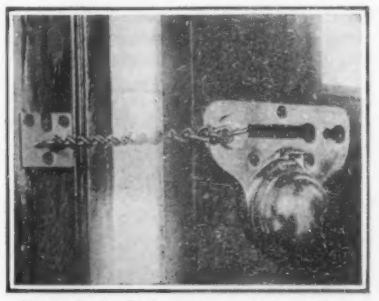
There was no mechanical means by which this could be done. In experimenting chemically, it was to be remembered that the law permits the use only of a few chemicals in cigars.

After tests, extending over the period of a year, a chemical substance was discovered.

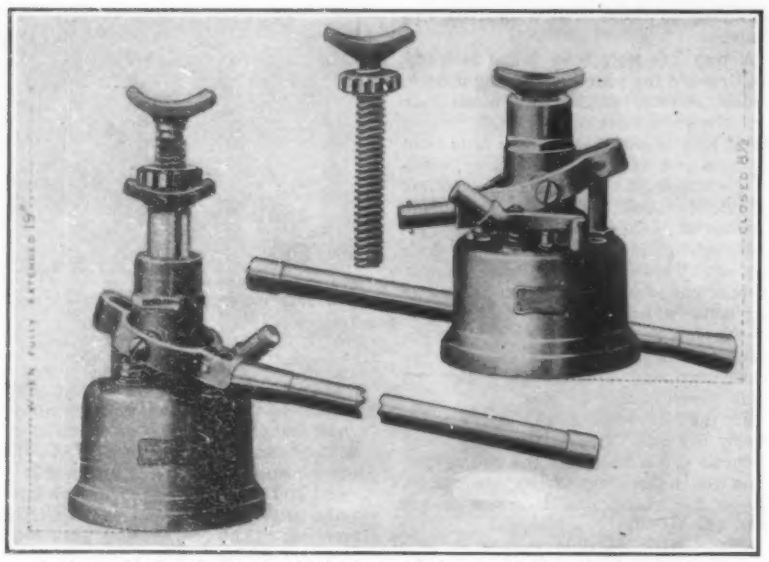
In fact, they discovered two things: that the refuse part of the tobacco plant can be utilized in the manufacture of cigars, and that cigars can be made of such a durable binder that they can be carried without any risk of breaking.

New Hydraulic Jack for Motorists

JACKS of the screw type waste nearly all the effort applied in overcoming friction between the spindle and the nut; by applying the hydraulic system, these losses are cut out and the car can be



Chain bolt that rings an alarm when it is meddled with



Assembled and disassembled views of the new hydraulic auto jack

lifted far more easily—jacking becomes a pleasure rather than a burden.

The base of a new British hydraulic jack consists of an aluminum alloy casting, measuring about six inches in diameter. The plunger carries a screw extension, its length is adjusted once and for all for a certain make of car, so that the jaw is just underneath the axle. Pressure is generated by two pump cylinders, one at each side of the gland fitting in the center of the base top. In this manner lifting is carried out during the up and down strokes, and the wheel is quickly lifted off the ground.

The jack is released by attaching the handle, the end of which has a bayonet fitting, to the release valve at the side of the pump cylinders; on depressing the lever, the liquid returns from the cylinder into the base, which acts as a storage chamber. When closed, the jack is 8½ inches high; fully extended, it measures 19 inches. The axle of a three-ton car can be lifted without any great effort. The total weight of the complete jack is only 14 pounds.

Longer Life for Auto Fan Belt

WHEN you get a complete automobile, starting system included, for less than $400, you naturally don't expect that it will stand up, without replacement of any essential part, as long as one that sets you back a couple of thousand, more or less. And experience bears out this expectation. In some respects, the vehicle affectionately known as Lizzie displays the most extraordinary endurance; in others she is decidedly a short-lived creature. Every owner finds that some one particular portion of her anatomy gives him more trouble than all the rest combined. Sometimes it is the brake and transmission bands that simply will not stand up; occasionally the connecting-rod and crank-shaft bearings go before their appointed time; more often the timer is the weak element. The majority vote of flivver owners would probably pick either the timer or the fan belt as her most frequently replaced member. The fan belt, in fact, is particularly the victim of poor design; the diameter of the upper pulley is so small that the belt is obliged to turn a corner sharper than any belt ought to turn, and the result is early failure. We know of one of these cars that never got more than 2000 miles out of a fan belt—until it tried the one illustrated herewith. To the evident explanation of the structure of this belt afforded by the picture little need be said, save that the lack of flexibility suggested by the photograph is not realized in the belt itself. Barring a little difficulty in getting it to pass through the space between the crank ratchet and the end of the crank-shaft, it is entirely a good belt; and on the car mentioned, it is still running after some 5000 miles. That, in fact, is its mission in life—to give the proprietor of Lizzie a belt that will outlast the one supplied by her manufacturer. This, it emphatically does. The secret is claimed to lie in resiliency; the belt is "built to give and come back."

Showing the construction of the longer-mileage fan-belt

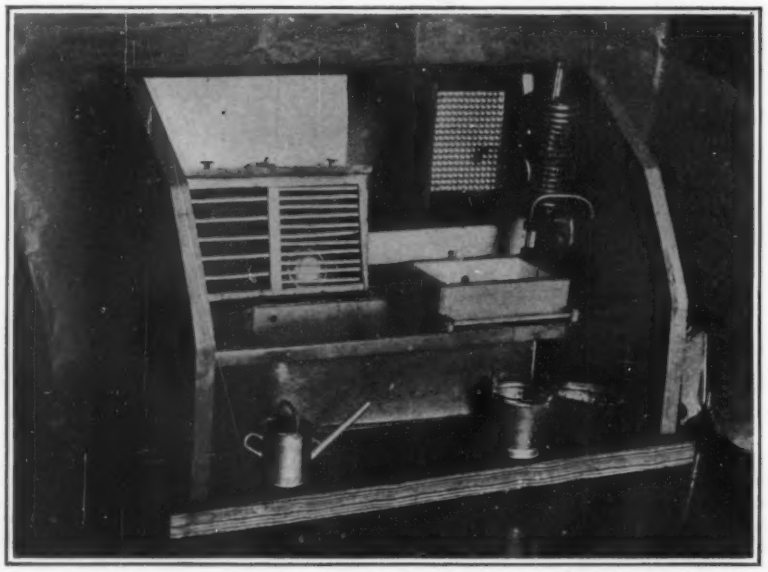
A Baby Giant Among Vacuum Cleaners

SEVEN and a half pounds for a vacuum cleaner, complete with all attachments, sounds like a wild dream; but it is none the less realized in the outfit illustrated. And not alone in lightness, but in several other ways, the new vacuum eliminates some of the annoyances of the old. It has bronze bearings of special design, automatically lubricated, so that no oil need be put in over a period of from three to five years. Portability is extreme, as the picture suggests. The terminals, always a source of trouble requiring service in the conventional electrical apparatus, are protected by vulcanized rubbers fitted to the cord in such a way that no bending or pulling of the cord puts any strain upon the terminals; as a result, contact is always positive. The bag is concealed and protected, yet can be emptied with less annoyance than in more familiar types, the maker tells us. There are no wheels or springs, and no switches.

A somewhat similar principle has been followed in developing a small vacuum cleaner for cleaning the automobile upholstery.

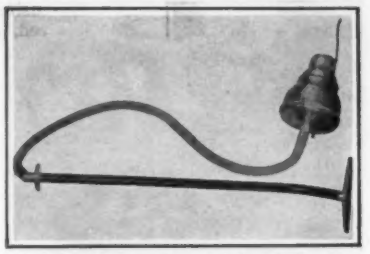
Saving Space in the Midget Apartment

WE have commented on these pages, we believe, upon the modern tendency in invention to combine two useful articles into one. Sometimes this tendency is properly a subject for satire. In our own humorous moments we employ, as a representative of inventions of the sort, an allegorical "combination baby carriage and spark-plug wrench." And a friend who is given to putting his



Bath and kitchen in one interchangeable unit for the bachelor and the bachelor maiden

humor into practice recently sent us a very neat little leather case, on the outside of which was stamped in gold letters "So-and-so's patent combination cigar-lighter and over-coat hanger." Opening the thing up, two inner compartments were revealed; in one of which reposed a match and in the other a wire nail.



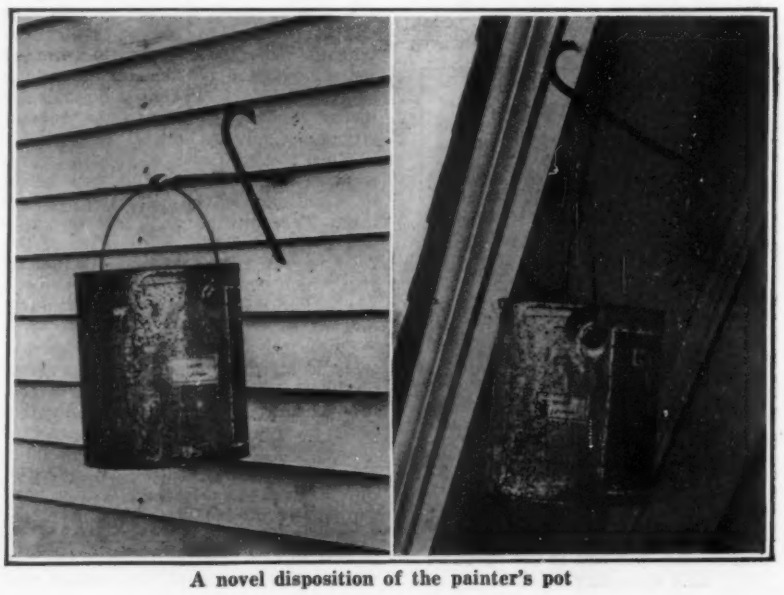
Cutting down the weight and complexities of the vacuum cleaner

Not all inventions of the combination type are ludicrous, however; and of those that deserve to be taken seriously we illustrate one. It sounds at first thought as though a combination kitchenette and bath room might be a joke, too, rather than a serious proposition; but our picture will deny this. For those who live alone in a room and a half, be they bachelors of the original variety or bachelor maids, the saving of space effected by using the same unit for bath and kitchen is a decided object—to say nothing of the somewhat reduced rent which the elimination of plumbing permits. The *modus operandi* consists in the main of a removable top for the bath tub. When this top is put on, a fold-up sink and a plate-rack are revealed in it and on it; when it is off, the same water supply feeds the bath. Both bath and kitchen are distinctly pint-size—but that is no novelty to the people to whom this invention is addressed.

A Hanger for the Paint Pot

ONE of the many troubles of the amateur painter, especially on outdoor work, is to keep the paint pot within ready reach and yet out of danger of being upset. In this connection the little hanger device, developed by a Middle West manufacturer, is of prime interest. Simple as this device is, it may be used to hold the paint pot almost anywhere. Considerable leverage is formed by the feet and the point, as will be observed in our illustration showing the device hanging on the side of a house, as well as the second illustration showing it holding on to the trim of the eaves.

The usual method of holding the pot of paint is an S-shaped piece of iron wire which serves to hold the paint pot suspended from a ladder rung.



A novel disposition of the painter's pot

The Wandering Rifle Bullet

SOME very interesting considerations concerning the path taken by the bullet fired from the rifle now in use by the United States Army have been raised by a letter of inquiry received from a reader of the SCIENTIFIC AMERICAN. This reader had been told by someone that soldiers are instructed to aim below and to the left of the bull's-eye, and asks whether the bullet does not fly straight to the point at which it is aimed.

It is a fact that the bullet does not follow a straight path, having two well-established horizontal deviations in addition to those caused by the wind. But other more important reasons are assigned for sometimes aiming below and to the left of the bull's-eye, and these will be given after a careful description of the interesting horizontal deviations.

We will imagine that the rifleman is shooting across a level plain, and that there is not a breath of wind. Some magic enables him to observe the bullet through its whole trajectory. When the rifle, which is the United States Magazine Rifle, Model of 1903, is fired, the bullet "jumps" to the left after it leaves the muzzle and at 300 yards it is about half an inch to the left of the prolonged axis of the bore. From this point an increasingly rapid drift to the right begins and carries the bullet back across the prolonged axis of the bore at about 500 yards from the muzzle. At 1000 yards the right-hand drift deviation is 13 inches. At 2000 yards it has increased to 12⅛ feet; while at 2850 yards, the limit for which the rifle is sighted, it is 40 feet. About half of the drift is corrected automatically by the sightleaf, but the jump to the left is so insignificant that it is ignored. It is simply an interesting phenomena. No satisfactory explanation of it has ever been given, but that there is a jump to the left is certain because if a rifle be placed in a vise and fired at a succession of paper planes placed at right angles to the line of sight the holes made by the bullet do not line up truly.

The drift to the right has a simple explanation, however. As the bullet leaves the muzzle it is drawn down by the force of gravity. This causes the air beneath it to become compressed, leaving a corresponding rarefication above it. The bullet rolls on this cushion of compressed air, and since it is spinning at an exceedingly high rate, caused by the right-hand twist of the rifling of the bore, which makes a complete turn every ten inches, this action is wholly comprehensible. The folding sightleaf of the rear sight contains a slide whose purpose is to elevate the peepsight in order to compensate for different ranges. But instead of raising the peepsight only vertically, it at the same time moves it slightly to the left.

The rifleman ignores the jump to the left entirely; he cannot split inches in his shooting, no matter how expert he may be. He can generally ignore the drift to the right also, because it is not very appreciable at the 100, 200, 300 and 500-yard ranges at which he does most of his shooting. In fact, up to 500 yards its only effect is in counteraction of the slight jump to the left.

These conditions are wholly independent of windage. For this, the proper corrections are made by a screw which moves the entire rear sight to left or to right by points marked on the windage scale; and the rifleman must know how to calculate windage by rule, and not guess at it.

It is a fact that recruits have sometimes been instructed to hold to the left of the bull's-eye because the tyro is apt to yank the trigger instead of slowly squeezing it, thus introducing an error which it is the hope of a tired or careless instructor to correct by the poor advice to hold to the left.

There are three possible reasons for instructing men to hold under the bull's-eye. First, nine out of ten people tend to shoot too high. This seems to be a matter of psychology. Often it is caused by faulty position and holding. But an instructor may have failed to impress the pupil with the necessity of learning to aim at what he wishes to hit and to make his corrections by means of the movable vertical and horizontal adjustments of the rear sight; so he may advise aiming quite far below the bull's-eye in order to counteract the common error.

There remains one special case in which men are justifiably instructed to aim below the bull's-eye when using the battlesight. This sight cannot be moved up or down to compensate for different ranges. It is fixed, as far as its vertical range is concerned, and it was arbitrarily set at 547 yards. This was because the Russo-Japanese war had just been fought when the army rifle was first issued and the long range fighting of that war influenced the judgment of the designers so greatly that the sight was fixed at what is now regarded as too great a distance for average battle conditions. Since at 500 yards the "drop" of the bullet, known as the summit of trajectory, is about 30 inches, it is evident that at ranges under 500 yards the bullet may fly high by something under that much.

Of course, the battlesight need not be used. There are four other sights on the rear of the rifle and one, the peepsight, can be run down to 100 yards. But this always takes time, the aiming cannot be done quite so quickly with the peep, and some men always manage to set it incorrectly. Hence the use of the battlesight, with the accompanying advice to aim below the bull's-eye. The rifle used by the United States Army is essentially an instrument of precision and permits of making accurate corrections for the various deviations of the bullet. However, this is not the cruder weapon used in the late war.

Sulfur and Its Many Uses

TO THE average person sulfur is of apparently little significance. He associates it with the slow burning match, the candle that is burnt in sick-rooms after contagious diseases. Popular conception has it that the lord of the nether regions is a close friend of sulfur, using it to herald his comings and to fill his domains with its asphyxiating fumes, as an emblem of his dread personage. A few may know that sulfur is an ingredient of gunpowder, but this is generally as far as common knowledge goes.

Originally practically all of the native sulfur came from the mines in Sicily. The abundance of the deposits and the ease of mining made the processes of recovering the sulfur very crude and inefficient. A great deal of the sulfur was formerly allowed to go to waste; it was actually burnt up during the refining operation. Today, the United States is a leading factor in the sulfur production of the world. As far back as 1868 it was known that sulfur existed in Louisiana, buried under quicksands and marsh land. The problem was to get it to the surface. This was solved in masterly manner by the chemist Frasch, and today large sulfur deposits in Louisiana and Texas as well are being worked. American competition has served to improve the sulfur extraction processes used in the Sicilian mines; it has resulted in an improvement throughout the entire industry. It has made possible the freedom of American chemical enterprise from unstable and unreliable foreign economic conditions and as a whole has stabilized the sulfur industry of the world.

Sulfur is a peculiar substance. It has a dual, in fact a triple, personality. It exists in three distinct forms and in each case it is just sulfur and nothing else, although its physical appearance is entirely different. Thus, for example, in one form it is crystalline, a bright yellow powdery substance; in another form it is plastic and amorphous, without any particular shape or form. It is stringy and can be pulled out like a rubber band; furthermore, it is dark colored, at times almost black.

Sulfur also behaves peculiarly when it is heated. At first it melts. Then as heat is applied further, it becomes hard again and finally on continual heating, it liquefies once more. More heating will cause it to distill. It is just this property of sulfur that makes it possible to work the Louisianian and Texan mines. These deposits are far below the surface; they were located accidentally in the search for petroleum. The mining is simple and effective. A well is drilled, just like in drilling for oil. After the casing is in place, two pipes are lowered. Hot water is passed down one tube. On reaching the sulfur, which is mixed with gypsum and other foreign substances, the hot water melts the sulfur, converting it into a liquid. The molten sulfur is then forced up the other tube by means of compressed air. The molten sulfur is allowed to run out in enclosures built right on the open surface and surrounded with wooden forms. The sulfur solidifies in a solid mass and is allowed to remain so, until ready for shipment, when it is blasted out and scooped up by means of bucket scoops. The sulfur wells are exhausted in time and then the tubing is lifted out, the well is closed and another one is drilled elsewhere on the location. The sulfur, that is mined in this way, is 99.9 per cent pure, containing but a few hundredths of a percent of mineral oil, petroleum, in addition to traces of other impurities.

Sulfur is one of the most important raw materials found in the earth. In the chemical and allied industries, such as rubber, food, paper, insecticide, etc., it plays a very essential role, more so than any other chemical element. First and foremost of its uses is the manufacture of the "king of chemicals," sulfuric acid, whose consumption is said to measure the progress of all industrial enterprise. Most people do not realize the peculiar significance of sulfuric acid, how much their welfare depends upon it.

The food that we eat is fertilized with materials that are made with the aid of sulfuric acid; the dyes that are used to color our fabrics, the gasoline that drives our motor cars, the lubricating oil that oils the bearings of our machines, the metals that are made into various articles of adornment and household utensils, such as knives, forks, etc., are all made with the aid of sulfuric acid. The pure water that we drink may be purified, freed of its algæ content through the aid of a product of sulfuric acid, copper sulfate. The acid enters into the process of dyeing, bleaching and finishing of all textile fabrics. It is responsible for the dynamite that blasts out our coal, for the celluloid that is made into toilet articles, for the moving picture films that entertain us after the hard day's work is over. The acid is used to make various products that enter into the manufacture of soap, glass, perfumes, drugs and many other products. In fact we can scarcely use an article that is not related to sulfuric acid in some way. Hence, it is not strange that the acid has been called the barometer of business, the indicator of the prosperity of the country. The importance of sulfur, more than half the production of which is employed in making sulfuric acid, is thus evident from this one use of the substance.

But there are other important uses of sulfur as well. For example, the paper on which the daily journals are printed is made with the aid of sulfur. The sulfur is utilized in the making of sulfite pulp, which is made up into cheap paper and which is also used in the manufacture of artificial silks, explosives, plastic compositions and as a binder in making asbestos paper and boards. Furthermore, sulfur is used as such in fertilizers. It is added directly to the fertilizer composition, which is then mixed into the soil. The particular value of sulfur for this purpose lies in the fact that the bacteria in the soil change it into sulfuric acid in time, which then acts upon the other ingredients of the fertilizer, principally the phosphates, and makes them available for plant food.

It may be news to the majority of people that sulfur is used in the treatment of certain foods, which are very familiar to them. Practically all dried foods are subjected to the action of sulfur fumes. Dried apples, apricots, peaches, prunes are treated in this manner. Almonds are bleached with sulfur dioxide, which is the gas obtained by burning sulfur. Barley, figs, grape juice, hops, molasses, maraschino cherries, oats, pears, peanuts, raisins, sugar are a few food products that are treated with this gas during the manufacturing process.

Sulfur, or rather the fumes from burning sulfur, are utilized in bleaching broom, from which brooms are made, cotton, felt, feathers, furs, hair, hemp, for making ropes, jute, linen, paper, rattan for making furniture, straw for making straw hats, wool, wicker furniture, willow ware and many other products. Sulfur is used for setting heavy engines, dynamos and other pieces of machinery on their foundations. This is accomplished by pouring the molten sulfur around the bolts to embed them in the concrete. A good cement can be made from a mixture of sulfur and cement, which can be used for special purposes, where it is desirable to fill in openings and at the same time take advantage of the antiseptic properties of the sulfur. Sulfur may be added to the water used by cattle and other stock, so as to keep them healthy. It is used in medicinal preparations for the treatment of human ailments as well.

Barrels are often disinfected by means of sulfur fumes. It has been found that the ordinary form of taper, a piece of paper dipped in molten sulfur, does not work so well due to the sulfur dripping off, so there has been devised the simple means of impregnating ordinary pipe cleaners in sulfur and using these tapers for various purposes. They can be hung in casks and barrels without any danger of the burning sulfur dripping off. They may be employed to locate leaks in ammonia lines in refrigerating and ice plants. The burning sulfur produces a white cloud wherever the ammonia is escaping. Florists find them useful in bleaching violets, orchids and other flowers. They are very useful for removing spots and stains from linen. They are used in hospitals as deodorants and fumigants and by bee-culturists in cleaning the bee-hives.

The Heavens in April, 1924

The Astronomer Adds an Extension to the Yard-Stick that He Uses on the Skies

By Professor Henry Norris Russell, Ph.D.

A COUPLE of months ago, we spoke of the measurement of the distances of the nearer stars. By direct methods of range-finding we can get out to about a hundred light-years with tolerable certainty. By studying the motions of the stars across the sky, and utilizing the apparent drift produced by the sun's motion in space, we can find the average distance of groups of stars with a precision of 10 or 20 per cent, even up to a thousand light-years—provided we have good observations, and enough stars to work with.

To measure greater distances we must find another means—and one of the most notable triumphs of modern astronomy has been the development of the new photometric methods of determining the distances of the stars. If we can find out, in any reliable way, how bright a star really is, and can measure how bright it looks, it is a very simple matter to figure how far off it is—and this method evidently reaches to the greatest distances at which one can see the stars at all. The obvious difficulty is to find some test by which we can pick out stars of some definite degree of real brightness; but several such tests are known.

A very important one, based on certain details of the spectrum, forms the foundation of the famous spectroscopic method of Adams and his colleagues at Mount Wilson. Another, used most effectively by Shapley, depends upon the fact—recognized long ago by Miss Leavitt at Harvard—that, among the variable stars of a certain type (called usually the Cepheid variables), there is a very close relation between the period and the actual brightness. These stars vary in a highly characteristic manner—continuously, regularly and periodically—so that they can be identified with certainty as of this sort, even if they are so faint that they appear, at most, as mere specks on our best photographs.

Great numbers of them are found in the Magellanic Clouds—those strange particles of light, like bits broken loose from the Milky Way, which appear in the southern heavens, and bear the name of the great navigator who first discovered them. Miss Leavitt, having worked out the periods of a number of the stars in the smaller of these clouds, found a singularly precise relation between their periods and their average brightness—the latter steadily diminishing, from periods of 100 days to those of a day, through some six magnitudes. Later work reveals the presence of many stars of even shorter period, down to half a day, which are still fainter, though not much so. Since these stars are all known to be really in the cloud and therefore at nearly the same distance from us, their real luminosities must be in the same proportion as those with which they appear to us to shine.

Brightnesses and Distances

Now a dozen and more variable stars of the Cepheid class lie near enough to us to be visible to the naked eye. For these we have good proper motions, and we can use the drift caused by the sun's motion to find their distance. It thus appears that such a star, with a period of eight days, is (on the average) about a thousand times as bright as the sun—whence it follows that the faintest, with periods of half a day or less, exceed the sun a hundred-fold in brightness; and the brightest, with periods of a hundred days, run up to the enormous figure of 50,000 times the sun's light. Such huge objects, however, are very rare. Having established this, it becomes a straightforward matter to calculate the distance of any variable star of the Cepheid type, or of any cluster or group of stars in which such variables can be found.

It was in this way that Shapley reached his epoch-making conclusions regarding the globular clusters—the nearest of which is 50,000 light years away, and the remotest more than 200,000. The distances of the Magellanic Clouds, too, can be found. Shapley estimates them at 80,000 light-years for the Small Cloud, and 110,000 for the Large; making the diameter of the first 5000 light-years and of the second 14,000.

Enormous as these distances are, they are quite surpassed by that of a more recently studied object. This is a very faint cloud of light in the constellation Sagittarius (in 19h. 40 m. R. A. and -15 degrees declination) which is known as N. G. C. 6822, since it bears that number in the "New General Catalog" of nebulae and clusters. Discovered by Barnard forty years ago, this object has been recently photographed by Perrine at Cordoba and Hubble at Mount Wilson, who agree in describing it as similar to the Magellanic Clouds, though much smaller and fainter. It is only ten minutes of arc long by five wide (as against 3½ degrees for the Small Magellanic Cloud and 7 degrees for the Large), and its brightest stars are of the magnitude 18.5, so that only long-exposure photographs with the most powerful instruments will show them.

Diffuse nebulae are found among the stars of the Magellanic Clouds, and also in the new object, though in the latter case they are only of about one-eighth the apparent size of those in the former. If we assume that the nebulae are really of the same size in the two cases, we conclude that N. G. C. 6822 is eight times as far off as the Clouds. If we assume that as a whole it is the same size as the Clouds, we arrive at distances 12 or 15 times as great. Finally, if we assume that the brightest stars in the new object are really similar to the brightest in the Clouds, we conclude that its distance is ten times as great. Combining these estimates (which are due to Dr. Shapley), we may conclude with some confidence that the distance of N. G. C. 6822 is of the order of one million light-years. This puts it far beyond all other known objects, and probably clean outside our galactic system; and adds another, and very striking, chapter to our advancing knowledge of the depths of space.

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.

At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 23.

At 9½ o'clock: April 30.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

The Heavens

The winter constellations are now lost to view, except where

"Starry Gemini hangs like glorious crowns
Over Orion's grave low down in the west."

(Tennyson was always accurate in his astronomy.) To the northwest we find Auriga, and on the north Cassiopeia and Cepheus—all low down. Lyra has come up in the northeast, and Cygnus is rising. Hercules is in the east, with Ophiuchus below, and Scorpio rising in the southeast.

Four great constellations are grouped around the pole: Ursa Major to the north (with Ursa Minor and Draco below); Boötes to the east; Leo to the west; Virgo to the south. Below the last two is Hydra, stretching from the south nearly to the west, with Corvus above, and Centaurus below—fully visible only in the tropics.

The Planets

Mercury is an evening star all this month, and is at his greatest eastern elongation on the 16th, 20 degrees from the sun. At this time he is excellently placed for observation, being nine degrees north of the sun, and remaining above the horizon until 8:20 P. M. Moreover, he is then in Aries, remote from any bright stars, and looks almost as bright as Capella, so that there should be no mistaking him. He will be conspicuous in the twilight for a week before and after the date named, but hard to see at the beginning and end of the month.

Venus is also an evening star, and also in elongation, on the 21st, nearly 46 degrees from the sun. No other planet is ever as conspicuous as she is at times like this, which recur every eight years, when she is simultaneously far away from the sun and as far north of him as she ever gets. She is 26 degrees north of the celestial equator and remains in sight until 10:40 P. M. Being a hundred times as bright as a first-magnitude star like Aldebaran, and ten times as bright as Sirius, she attracts even the most casual glance. Her light, falling through a window on a white wall or screen, casts a distinct shadow and she is easy to see in broad daylight, if one only knows where to look for her. On the 7th and 8th the moon may serve as a guide; but, being more than 8 degrees south of the planet, as a rather poor one.

Mars is in western quadrature on the 13th, and is already as bright as Procyon; but he is so far south, in Sagittarius, that he does not rise until 1:30 A. M.

Jupiter is in Ophiuchus, rising at 11 P. M. and crossing the meridian at 3:40 A. M. in the middle of the month.

Saturn is in Virgo, and comes to opposition on the 19th. His rings appear more widely open than for some years past, and he is therefore brighter, equaling Procyon.

Uranus is in Pisces, and comes to the meridian between 3 and 4 A. M. Neptune is in Leo, and visible all the evening.

The moon is new at 2 A. M. on the 4th, in her first quarter at 6 A. M. on the 12th, full at 9 A. M. on the 19th, and in her last quarter at 11 P. M. on the 25th. She is nearest the earth on the 20th, and farthest away on the 8th. During the month she passes near Uranus on the 2nd, Mercury on the 5th, Venus on the 8th, Neptune on the 14th, Saturn on the 19th, Jupiter on the 22nd, Mars on the 25th, and Uranus again on the 29th.

Modern Ideas in Old Mexico

DR. J. WALTER FEWKES of the Bureau of American Ethnology at Washington, hardy perennial explorer of the regions of the New World that give evidences of the antiquity of western civilizations, has found some pictures on pottery from New Mexico which present a distinct comedy aspect. These paintings would indicate that the gentle art of gambling with dice and keeping track of the state of the game with counters corresponding rather well to the poker chip of modern life, was well known in the prehistoric southwest. Another aspect of modern civilization in which we appear to have been forestalled by these Indian races, if the evidence of the potters brush is to be believed, is the dancing chorus girl of scanty attire.

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.

Pertaining to Aeronautics

FLYING MACHINE — Having propulsion means which may be utilized for driving or lifting an airplane or aeronautical apparatus. Patent 1476162. J. A. Lehnert, Howard, S. D.

Pertaining to Apparel

COLLAR STUD SUPPORT—The object of which is to prevent the stud pressing upon the thyroid gland. Patent 1473549. A. Goldknopf, 200 W. 111th St., New York, N. Y.

COLLAR FASTENING DEVICE—For associating a collar with the rear portion of a shirt neckband. Patent 1473460. G. L. Brisbin, Brisbin, Mich.

GARTER CONSTRUCTION—Whereby the hosiery to be gripped by the clasp, can be easily attached or detached therefrom. Patent 1475868. G. W. Peterson and J. P. Yenetis, address G. W. Peterson, c/o Postmaster, N. Y. City. U. S. S. "Prometheus."

HEAD AND SOCKET FASTENER—For clothing, so constructed that it will remain closed until opened by the wearer. Patent 1475865. Rosa M. Peters, c/o Peters Bros. Rubber Co., 4109 Park Ave., New York, N. Y.

Chemical Processes

PROCESS FOR THE SYNTHETIC PRODUCTION OF ALKALI—Metal cyanides. Patent 1472403. F. Von Bichowsky, 1412 San Fernando Blvd., Glendale, Calif.

Electrical Devices

ELECTRIC POWER DEVICE—In which a current is generated without any appreciable loss of power or lighting circuit. Patent 1471957. W. C. Hahne, 712 S. Charles St., Elgin, Ill.

AUXILIARY MOUTHPIECE FOR TELEPHONES—Whereby all sound waves of the voice are directed into the mouthpiece and external sounds prevented from entering. Patent 1474100. O. W. Aagaard, 5144 N. Albany Ave., Chicago, Ill.

THERMOSTATIC SWITCH FOR FLATIRONS—Capable of being associated with an electric iron of standard construction. Patent 1474588. R. D. Hetrick, Box 226, Indiana, Pa.

METHOD AND APPARATUS FOR CONTROLLING SUGAR CENTRIFUGALS—And similar devices which are electrically operated. Patent 1475121. F. H. Jones, Tuinucu, Cuba.

CIRCUIT CONTROLLER—To be used particularly in connection with refrigerating apparatus. Patent 1475313. A. G. Newhard, 617 Hanover Ave., Allentown, Pa.

TROLLEY — For overhead electric wires, which increases the area of contact between wheel and wire. Patent 1478311. J. T. Welsh, Westfield, N. J.

FIXTURE SUPPORT—Which will not only support an electric lamp but a canopy as well. Patent 1478595. F. E. Wooley, Box 112, Manasquan, N. J.

CONTROLLING AND REGULATING SYSTEM FOR DYNAMOS—Which may be used as indicating lamps, mounted in guard casings, in the vicinity of persons supervising the system. Patent 1475880. W. J. Rickets, 32 Torrens Rd., Brixton Hill, S. W. No. 2, London, England.

ELECTRIC SOLDERING IRON—In which the heat transmitted to the soldering point may be regulated. Patent 1478319. E. Young, c/o Adroit Tool Co., 14 Front St., New York, N. Y.

IMPLEMENT FOR WRITING—In the form of a pencil having a self-contained electrically heated scoring point. Patent 1455842. W. F. KELLY, 915 W. Front St., Greenwood, Miss. (See Fig. 1.)

Of Interest to Farmers

WEEDER—In which the weight of the machine enables the weeder bar to uproot the weeds. Patent 1472749. G. W. Fairbourn. R. D. No. 2, Box 39, Salt Lake City, Utah.

PLOW—Especially adapted for cotton cultivation. Patent 1472728. J. E. McNeil, Raleigh, Tenn.

HOG TROUGH—That may be secured against movement, or may be shifted from place to place, for feeding hogs. Patent 1473100. M. J. Hosch, Randolph, Neb.

ATTACHMENT FOR DISK HARROWS—Which will gage the depth of the cut made by the disks and may be attached to harrows of ordinary construction. Patent 1475312. T. D. Moran, Dillon, Mont.

DITCH DIGGER—In which the cutting depth may be varied, and the dirt conveyed to either side of the ditch. Patent 1475550. A. Naylor, c/o M. Purdin, 406 Medford Bldg., Medford, Oregon.

IRRIGATION DITCHER—Which is adjustable for varying depth and width of cut, and in which the cutting edges are self-sharpened. Patent 1477033. R. C. Chattin, Mountain Home, Idaho.

CONVERTIBLE DRYING KILN AND CRIB—Constructed entirely of cement and steel, for receiving and storing corn or other grain. Patent 1477682. G. W. Atherton, 629 So. Walter St., Albuquerque, N. Mex. (See Fig. 2.)

CHURN—Adapted to be manually operated, or operated by mechanical power. Patent 1478748. J. A. LAWRENCE, Lindsay, Okla.

PRESS—Which automatically feeds material into a baling chamber for moving bales. Patent 1478450. C. D. Melton, Eustace, Texas.

CATTLE GUARD—Formed of spaced supporting members placed over a ditch, which will tend to obstruct the passing of cattle. Patent 1478927. W. A. Tomlinson, 346 W. Monroe St., Phoenix, Ariz.

Of General Interest

ENVELOPE—Capable of being used for sending and returning mail matter. Patent 1470335. N. Sternheimer, 3901 Lester St., Richmond, Va.

SAFETY RAZOR—The parts of which may be readily cleaned without resorting to disassembling. Patent 1469715. A. S. Breakey and C. F. Pietsch, c/o A. S. Breakey, c/o Frank Seaman, 470 4th Ave., New York, N. Y.

COPYHOLDER—Especially adapted for typists' use, for holding copy in place. Patent 1469749. A. N. Woodruff, Box 1907, Washington, D. C.

WATCH FILLER RING—For utilizing a small watch movement in a large case. Patent 1469735. A. L. Stearns and A. W. Hofmann, c/o Roy Watch Case Co., 15 Maiden Lane, New York, N. Y.

PLUG FOR ICE AND HOT WATER BAGS—Which may be quickly operated to seal the mouth of the bag. Patent 1471103. A. Connor, c/o Universal Hospital Supply Co., 500 N. Dearborn St., Chicago, Ill.

LOCKING DEVICE—For coupling tubular members together in alinement and normally preventing disconnection. Patent 1471077. C. Vogt, 1859 Washburn Ave., Chicago, Ill.

TRENCH MORTAR—Which can be used individually, or in connection with others to form a battery. Patent 1471063. F. Rognlie, c/o G. H. Burgenhagen, Weinrebe Bldg., Minot, N. D.

INDIVIDUAL PIE CONTAINER—Which is leak-proof and in which a piece of pie may be readily carried. Patent 1470763. A. J. Richards, 4515 Emerald Ave., Chicago, Ill.

METHOD OF DECORATING LEATHER OR SIMILAR MATERIAL—Whereby a design may be easily applied with a background of any color. Patent 1470535. F. A. Kolb, 65 13th Ave., Newark, N. J.

TUBE SQUEEZER—Especially intended for squeezing tubes containing toothpaste. Patent 1470534. S. J. Keiper, 317 E. 83d St., New York, N. Y.

MEASURING TRIANGLE—Whereby the circumference of a circle can be obtained by the reading of a scale. Patent 1470530. C. Hohmann, 755 Peterson Ave., Jersey City, N. J.

POCKET FILE CASE—Designed to be carried in the pocket for housing a card index system. Patent 1470549. H. Steinmeyer, 1446 Hurlbut Ave., Detroit, Mich.

ARTIFICIAL PLANT—Which may be used for outdoor decoration, maintaining its shape regardless of the weather. Patent 1470516. Jennie M. Weyandt and Mary Tafarella, 1761 Aralon Road, Cleveland, Ohio.

CONTAINER HANDLE—Adapted to be applied to containers holding shoe polish or the like. Patent 1470536. E. A. Lange, Claresholm, Alberta, Canada.

RECEIVER SUPPORT FOR SOUND AMPLIFIERS—Which may be easily attached to the ordinary type of phonograph horn. Patent 1469941. C. W. Kuen, 1520 Edgewater Ave., Chicago, Ill.

CLOTHESPIN—Which will grip the clothes and suspend them from the line without bringing them into contact. Patent 1478353. P. C. Partenio, 139 Pearl St., Brooklyn, N. Y. (See Fig. 3.)

TOY ANIMAL AND METHOD OF MAKING SAME—In such manner that it may be washed with soap and water without injury. Patent 1478348. L. Myers, 108 E. Fulton St., Gloversville, N. Y. (See Fig. 4.)

CONDENSING LENS—By means of which the ultra-violet rays in light generated by high-power lamps may be neutralized. Patent 1470512. M. E. Tromba, c/o Paramount Lens Co., 40 Clifford St., Providence, R. I.

NAIL BUFFER—With means for removably associating the chamois with the buffer proper. Patent 1470857. J. Lupo, c/o Columbia Manicure Mfg. Co., 3606 Park Ave., Bronx, N. Y.

POCKET MEDICINE RECEPTACLE—Especially adapted for carrying a small number of doses of medicine. Patent 1470547. H.

6.—WHAT IS INFRINGEMENT OF A PATENT?

THE invention covered by a patent is defined by the claim or claims thereof. In order to infringe a patent, the alleged infringing process or structure must fall within the scope of at least one of the claims, that is, such claim must define the infringement. Furthermore the latter must embody all of the elements or features of the claim arranged and organized as specified therein. If a single such element or feature is wanting, there is no infringement. Any one who without ownership or license makes or uses or sells an infringing article violates the patent right. Even making an infringing device for one's personal use only, constitutes an infringement. On the other hand, making an infringing article merely for the purposes of experimentation or improvement is not necessarily an infringement. Infringement of a patent is always a question of fact. Frequently infringement cannot be determined on its face and the claim must be interpreted in the light of the prior patent and other art as to whether or not it is to be construed broadly or otherwise. Frequently a patent which on its face appears to be infringed, when construed so that its place in the art can be determined, is found not to be infringed because it must necessarily be given a narrow construction. In order to infringe a patent it is not necessary to infringe every claim thereof. If one claim only is infringed, the right is violated even if there are other claims which are not infringed. Infringement is often a question of equivalency, that is, the alleged infringing structure may not comprise the exact elements or features of the claim, but if it includes certain structural elements which are the mechanical equivalent of those defined in the claim, the latter is infringed.

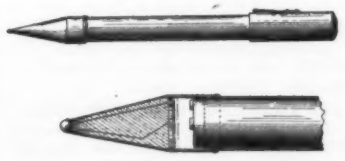


Fig. 1. Scoring pencil with self-contained electrically heated point, invented by W. F. Kelly

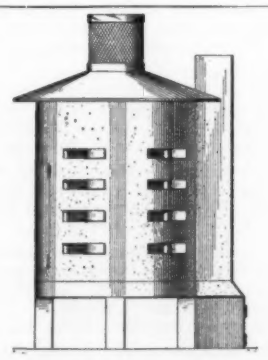


Fig. 2. G. W. Atherton's drying kiln and crib of cement and steel, for receiving and storing grain

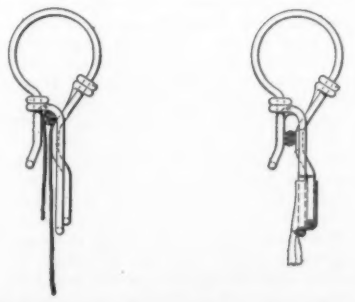


Fig. 3. Clothespin which refrains from contact with the clothes, the invention of P. G. Partenio

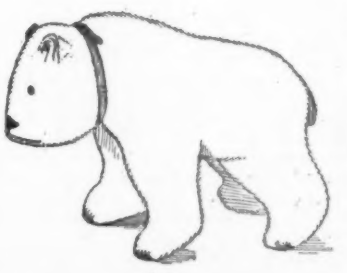


Fig. 4. Toy animal, of the Teddy Bear or other persuasion, which may be washed with soap and water, as patented by L. Myers

A. Schilling, 10454 114th St., Richmond Hill, L. I., N. Y.

SAFETY ENVELOPE—Which cannot be opened without being mutilated. Patent 1470715. G. Doutney, 567 Halsey St., Brooklyn, N. Y.

SAFETY PORTABLE SCAFFOLD—For use by painters, carpenters and others doing work requiring a platform. Patent 1471304. J. F. Young, 1168 E. 53d St., Los Angeles, Cal.

METHOD OF MAKING ARTIFICIAL FLOWERS—Which shall be an exact reproduction of the natural flower. Patent 1470969. M. B. Greene, The Homestead, Yarmouthport, Mass.

SIFTER TOP FOR CONTAINERS—More particularly for powder cans or the like. Patent 1471298. L. A. Wegenaar, 320 83d St., Brooklyn, N. Y.

FISH LURE—Designed to attract so-called game fish, and to effect economy in the use of bait. Patent 1470842. H. T. Hyams, 1st State Bank Bldg., DeKalb, Texas.

TOILET ARTICLE—Which affords facilities for removably holding a lipstick or the like. Patent 1470994. J. B. Mason, Jr., 308 Stahlman Bldg., Nashville, Tenn.

HAIRPIN—Which automatically locks itself in the hair. Patent 1471612. F. V. Kosatka and E. Stepkal, c/o F. V. Kosatka, 2241 S. 59th St., Cicero, Ill.

FRUIT BASKET—With movable handle so that a number of baskets may be nested for shipment. Patent 1471953. P. J. F. Gallagher, Box 446, Marlboro, N. Y.

METHOD AND APPARATUS FOR THE REDUCTION OF IMPURITIES CONTAMINATING MOLTEN METALS—By filtering the molten metal through molten slag and cinders. Patent 1472006. L. Jones, 928 Wheeling Ave., Muncie, Ind.

HEAT AND COLD INSULATING RECEPTACLE AND APPARATUS FOR SUPPORTING AND FINISHING THE SAME—In which a vacuum chamber is sealed in a novel manner. Patent 1472019. J. E. Hitch, 313 Sycamore Ave., Cincinnati, Ohio.

MATCH CASE—For book matches in the cover is provided a slot which registers with the scratching surface. Patent 1471912. J. Oppenheim, c/o Dasco Import Co., 384 Broadway, New York.

CATCH BASIN—For sewer traps which will prevent solids from entering the sewer. Patent 1471819. J. H. Bauschard, 1025 Holland St., Erie, Pa.

FLY HOOK—With means for effecting engagement with a fish line. Patent 1471959. P. F. Halferty, 314 E. Pike St., Seattle, Wash.

FILING SYSTEM—In which any card may be instantly removed. Patent 1472020. W. H. Holmes, Central Blvd., Mount Vernon, N. Y.

COOKING UTENSIL—For frying oysters or French fried potatoes. Patent 1472205. A. H. Brunner, Cottage Cafe, Carbondale, Ill.

ARTICLE SLICING DEVICE—Which affords facilities for slicing bread to a uniform thickness. Patent 14722219. O. N. Hoffman, 1651 So. State St., Syracuse, N. Y.

OIL OR GAS WELL CASING—For sealing the annular space around the tubing. Patent 1472555. E. V. Crowell, Box 1479, Station C, Los Angeles, Calif.

ADJUSTABLE DOORSTEP—Which will effect the stopping of the door at predetermined points. Patent 1472531. G. T. Morris, 1130 So. Higgins Ave., Missoula, Mont.

HOSE REEL—In which the nozzle is carried by the device and is movable to any point within the length of the hose. Patent 1472747. I. A. Crocker, 508 So. Elm St., Kankakee, Ill.

TESTING AND SAFETY DEVICE FOR TRAPS—Permitting a limited movement of the traps toward its closed position for setting the trigger. Patent 1472666. T. L. Munroe, 219 New Boston Rd., Fall River, Mass.

AUTOMATIC CONTROL FOR WINDOW SHADES—Which causes the shade to be lowered in rainy weather. Patent 1472703. R. Walser, 122 Franklin St., Union Hill, N. J.

CONCRETE BLOCK CONSTRUCTION—Which permits of firmly locking the blocks together in a simple and quick manner. Patent 1472680. M. Roffino, 84 Charles St., New York, N. Y.

DENTIPHONE—For more clearly hearing music recorded by a talking machine. Patent 1472214. J. W. Gonce, Anderson, Tenn.

FOLDING CONTAINER—Adapted to conveniently accommodate both hair nets and hair pins. Patent 1472755. A. L. Hawes, c/o Empire Notion Co., 72 Madison Ave., New York, N. Y.

BURGLAR ALARM—Adapted for use in connection with containers such as safes. Patent 1472750. J. F. and F. C. Gorman, 1339 University Ave., Bronx, N. Y.

CLOTHESLINE BRACKET—To be swung exteriorly of a window when in use. Patent 1472705. R. Wardhaugh, c/o Mrs. Murry, 2441 Coney Is. Ave., Brooklyn, N. Y.

CASTING ROD—For automatically shooting a projectile carrying a line, hook and bait to a desired distance. Patent 1473507. C. A. Obermaier, Box 442, Lompoc, Calif.

CLOSURE FOR BOTTLE—Which will securely close the bottle or vial, yet present an attractive appearance. Patent 1473540. C. L. Bernardo, c/o Floral Products Co., 301 W. 125th St., New York, N. Y.

FOLDING CROSS—Comprising a hollow base acting as a container, the whole making a small package. Patent 1473530. H. T. Walrow, 448 W. 35th St., New York, N. Y.

GOLF PUTTING BOX—By means of which persons may train themselves to put accurately both for direction and force. Patent 1473051. A. B. Scott, Fairmont, W. Va.

FILM DRYING APPARATUS—Whereby material such as motion picture film can be efficiently dried in a short time. Patent 1473542. G. L. Chanier and A. L. Adatte, c/o Pathe Exchange, 1 Congress St., Jersey City, N. J.

ROLLER CURTAIN GRINDING AND LOCKING DEVICE—For preventing any flapping of porch curtains or the like. Patent 1473517. W. M. Richards, 222 E. 59th St., Chicago, Ill.

ATMOSPHERIC COMPOUND FOR DIVERS' USE—By means of which the period of work under water can be increased. Patent 1473337. C. J. Cook, 33 B Street, N. W., Washington, D. C.

COUPLING—For attaching a hose or the like to faucets of varying sizes. Patent 1473537. H. Bailey, 2307 Morris Ave., New York, N. Y.

CHERRY AND CONFECTION CENTER DEPOSITING APPARATUS—By means of which a number of operators may be dispensed with in the laying of cherries, nuts, etc. Patent 1473458. T. Bosshard, St. Albans, Queens Co., N. Y.

SOUND CLARIFIER—For the projection of sound waves such as occur in talking machines. Patent 1473560. C. W. Johnson, Box 59, Genl. P. O., New York, N. Y..

INDICATOR—Which is capable of wide use, but particularly for displaying prices at gasoline stations. Patent 1473472. J. F. Dodd, 67 Lincoln Ave., Delaware, Ohio.

SHEET OF MUSIC—Which may be read by persons unfamiliar with the theory and technique of music. Patent 1473495. F. R. Miller, 2920A Jackson St., San Francisco, Calif.

DOOR AND FRAME CONSTRUCTION—For the oven of a stove, which will swing automatically to closed or open position. Patent 1473978. E. Schmale, c/o Belleville Stove & Range Co., Belleville, Ill.

OILER—By means of which oil cups at an elevated point may be conveniently lubricated. Patent 1473852. L. S. Harrell, 633 Middle St., Baton Rouge, La.

CALCULATOR—Which will enable the user to ascertain the board feet in a given number of pieces of lumber. Patent 1473948. A. L. Beck, c/o Orlando Novelty Works, Orlando, Fla.

WATER CLOSET VALVE—By which a portion, or the entire contents of a tank may be drained at will. Patent 1474288. H. A. Rath, 141 Jefferson Ave., Elizabeth, N. J.

HUMIDOR—For preserving the aroma of cigars in an ordinary cigar box. Patent 1474254. J. Gerstle, 515 W. 157th St., Aptm. 7, New York, N. Y.

ALARM CLOCK RELEASE FOR PHONOGRAPHS—Which when the alarm goes off, will permit the phonograph to play and wake the sleeper. Patent 1474240. L. Crane, c/o Fine, 1670 Boston Rd., Bronx, N. Y.

FRUIT DRIER—Intended for domestic use over an ordinary cook-stove or suitable heater. Patent 1474687. J. B. Raby, Jr., R. 6, Box 42, York, Pa.

FOUNTAIN BRUSH—Such as are used for dispensing paste. Patent 1475116. E. H. Harvey, 331 Market St., Lewisburg, Pa.

VAPOR BATH—Including a rest supported in a bath tub and a canopy disposed over the same. Patent 1475091. J. Thomas, Aberdeen, Wash.

SUPPORT FOR ALARM CLOCKS—Which lends to the clock an ornamental appearance. Patent 1475137. J. Oppenheim, 404 W. 145th St., New York, N. Y.

HAIR NET CONTAINER—In which a hair net may be packed without being crushed or wrinkled. Patent 1475130. H. Mauer, c/o Seidner & Hitzigrath, 1140 Broadway, New York, N. Y.

LADY'S SAFETY POCKETBOOK—With means for preventing the opening of the same without detection. Patent 1475132. T. L. Monaghan, 19 E. 101st St., New York, N. Y.

FLYTRAP—Which automatically traps and collects the flies into a suitable receptacle. Patent 1475095. H. Van Hees, Hotel Manze, Trenton, N. J.

SHAVING MUG—With means for maintaining the contents in a heated condition. Patent 1475905. E. D. Van Horsen, Three Forks, Mont.

LIFEBOAT RELEASE—Which may be operated from the boat with which the same is associated. Patent 1475617. S. E. Allbin, c/o Mayer Life Boat Co., 411 Haller Bldg., Seattle, Wash.

FLUSH TANK—That does away with floating lift valves, wires and rubber balls. Patent 1475841. D. McNeill, Huntington, W. Va.

WINDOW SCAFFOLD—That may be set up and collapsed quickly and adjusted to different size windows. Patent 1475780. C. R. Basini, 546 Roosevelt Ave., Cateret, N. J.

IMPLEMENT FOR CLEANING TEETH—Formed by utilizing the handle of the brush as a holder for a dental floss or gauze. Patent 1475789. T. A. Buckley, 530 Nostrand Ave., Brooklyn, N. Y.

HOUSE NUMBER AND STEP ILLUMINATOR—Which effectually displays the number and illuminates the steps after dark. Patent 1475866. C. P. Peterson, 1725 E. 4th St., Brooklyn, N. Y.

SANITARY BELT—Comprising a girdle with detachable tabs, and means for removing the tabs and the napkin. Patent 1475895. J. Stein, c/o Climax Rubber Co., 520 Broadway, New York, N. Y.

SECURING DEVICE—Designed for fastening a plurality of pieces of leather, metal, or other material. Patent 1475827. L. J. Hogarty, 5 Beekman St., New York, N. Y.

VEGETABLE GRATER—Which may be mounted on a suitable receptacle, for receiving the grated vegetable. Patent 1475839. L. Leitman, P. O. Box 206, Mount Vernon, N. Y.

REMINDER SIGNAL—For imparting to the owner recollection of an intended action. Patent 1475780. H. L. Beach, Disbursing Office, U. S. Naval Station, Carile, Philippines.

METHOD OF PRESERVING EGGS—Which in no way effects the edibility, or requires special conditions for storage. Patent 1475804. R. Du Bois and H. I. Jones, c/o Dept. of Chemistry, Okla.; A. & M. College, Stillwater, Okla.

UMBRELLA STAND—So constructed as to provide a separate compartment for each umbrella. Patent 1476599. G. De Witt, 5 John St., Gloversville, N. Y.

INDEX FILE—Particularly adapted for use, such as would be suitable for salesmen, etc. Patent 1476662. R. J. Weinacht, 366 Amsterdam Ave., New York, N. Y.

CIGARETTE APPLIANCE—For manually rolling cigarettes, and also forming a receptacle for the tobacco and papers. Patent 1476652. M. M. Shore, 631 E. 138th St., New York, N. Y.

EDUCATIONAL APPARATUS—Which will materially assist students to visualize the geographic location of places. Patent 1476,671. J. S. Crate, 609 White Oak St., Houston, Texas.

KEY HOLDER—Which is provided with a plate to which a plurality of key holding elements are attached. Patent 1476642. D. I. Reiter, 100 5th Ave., New York, N. Y.

POURING SPOUT—For pouring milk or other liquids from tin or other cans. Patent 1475988. V. Dieu, c/o Lewis Oil Co., R. R. No. 2, Breckenridge, Texas.

MOPS—Having a cleaning element which may be detached for renewal, or may be adjusted. Patent 1476318. W. H. Zachry, c/o Atlanta Variety Works, St. Charles, Lakeview and Greenwood Ave., Atlanta, Ga.

MOP—With means for adjustment for preventing the free swinging of the head. Patent 1476317. W. H. Zachry, c/o Atlanta Variety Works, St. Charles, Lakeview and Greenwood Ave., Atlanta, Ga.

METHOD OF RESTORING OR REJUVENATING BALE-TIE BANDS—By annealing and cold rolling the pieces, to elongate them while maintaining their width. Patent 1476346. R. Margolius, Box 73 West End Annex, Richmond, Va.

DENTAL THREAD HOLDER — Especially adapted for use in cleaning one's teeth, with dental floss. Patent 1475986. C. C. Cooke, Morton's Gap, Ky.

BRACKET FOR MOUNTING PULLEYS—Upon which a pulley may be rotatably carried, and shifted for tightening the cable. Patent 1477229. G. R. Northrup, c/o W. H. Hayes, 1st Natl. Bank Bldg., Laramie, Wyo.

SMOKING PIPE—In which the smoke is cooled and purified before reaching the smoker's mouth. Patent 1477029. A. G. Blomster, Amidon, N. D.

GUN SIGHT—By means of which the proper elevation of the muzzle may be found with both eyes open. Patent 1476884. E. E. Gregory, 425 5th Ave., New York, N. Y.

PRINTER'S CHASE—By means of which a type form can be quickly and accurately centered. Patent 1477046. A. C. Evans, 331 W. Gold St., Butte, Mont.

SELF-SERVICE STORE—In which customers can readily select and serve themselves with the various commodities. Patent 1477492. M. R. Hutchison, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N. Y.

HORSESHOE—Of combined rubber and metal, the rubber being anchored by key members. Patent 1477007. F. C. Robertson and P. P. Rooney, c/o F. J. Nelson, Hornell, N. Y.

SEWER BASIN HEAD—Including a main body section and a curb section which may be detached. Patent 1477435. J. J. Fagan, Coles and 14th St., Jersey City, N. J.

TOBACCO CONTAINER—For the reception of leaf tobacco, the entire contents of which may be exposed without removing the same. Patent 1477105. T. R. Brumfield, 402 No. Union St., Danville, Va.

INSECTPROOF PORTAL CONSTRUCTION—By means of which insects are precluded from passing from the outside to the inside of a building. Patent 1477497. M. R. Hutchison, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N. Y.

OIL WELL PACKER—For preventing any fluid detrimental to the well from flowing through the casing. Patent 1476727. J. S. Quigg, c/o Star Machine Works, Box 25, Dewey, Okla

PRINTING FRAME—For use by photographers, adapted for printing by artificial or natural light. Patent 1478217. D. W. Gray, 131 E. 5th St., Los Angeles, Cal.

BELTING—Which will not stretch, unravel, or pull out from the splicing. Patent 1477707. W. S. Langford, c/o Mt. Vernon Belting Co., Baltimore, Md.

PACKING GUIDE FOR FRUIT AND VEGETABLE CONTAINERS—For use where it is essential that jostling is prevented in transit. Patent 1477542. G. L. Comlossy, 408 Produce Exchange Bldg., Toledo, Ohio.

SANITARY CUSPIDOR—For use in households, hospitals, and public places. Patent 1477005. S. Rianda, R. R. No. 5, Box 16B, Watsonville, Cal.

BELT ATTACHMENT—Providing a simple means whereby a pencil may be carried on one's belt. Patent 1477551. C. A. Eva, 609 Henderson St., Austin, Texas.

INDICATOR FOR CAMERAS—Which includes mechanism for preventing a double exposure. Patent 1478318. E. M. Woodworth, 346 So. Goodman St., Rochester, N. Y.

UNIVERSAL JOINT—Constructed as to permit a ready uncoupling when moved to abnormal position. Patent 1478324. A. Dina, 161 Jefferson St., Woodbridge, N. J.

VENTILATOR—Especially designed to prevent the formation of steam on show windows. Patent 1478312. A. Wenger, 432 Broadway, Bayonne, N. J.

IRONING TABLE—Which may be folded into compact form when not in use. Patent 1478951. E. L. Golden, c/o Am. Woodenware Co., Manistee, Mich.

TAP DEVICE FOR WOODEN BARRELS—Particularly applicable to barrels containing malt syrup, glucose, vegetable cooking oils, etc. Patent 1478918. W. Rupp, c/o Universal Rug & Carpet Cleaning Co., 449 Central Ave., Newark, N. J.

CLEANING CLOTH—Which can be effectively attached to either hand, without losing the area of the cloth. Patent 1478914. J. Ritzenthaler, 73 Franklin St., New York, N. Y.

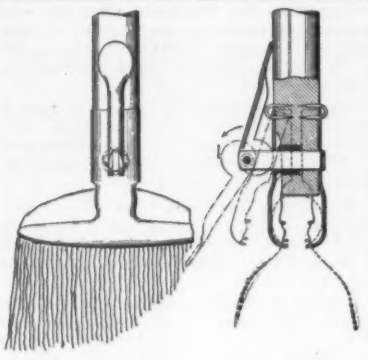


Fig. 5. Easily removable, metal jawed mop handle, the invention of W. H. Jayne

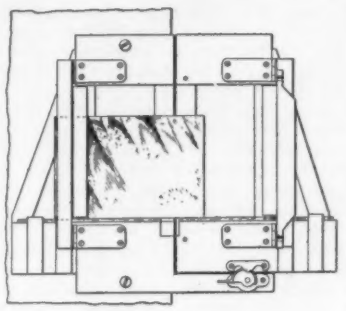


Fig. 6. Glass-cutting frame for use in horizontal or vertical position, designed by M. L., E. J. and A. L. Shaw

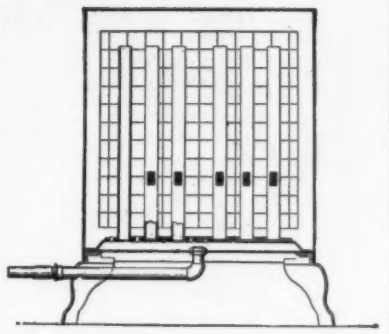


Fig. 7. J. P. Lane's gas stove on which the flame is controlled through openings in the combustion tubes

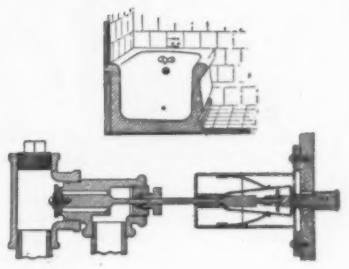


Fig. 8. Mechanism for the operation of fluid valves without the use of projecting heads, developed by A. G. Bertram

RUDDER—For use in the navigation of screw propelled vessels. Patent 1478928. J. J. Toner, 289 W. 142d St., New York, N. Y.

PROCESS FOR MAKING MEAT CASINGS—Which will not contain any substance injurious to the health or develop any chemical actions. Patent 1478968. C. S. Lenz and H. M. Cohen, c/o Jupp, 600 W. 139th St., New York, N. Y.

WINDOW CONSTRUCTION—By means of which a person may clean both sides of a window from within the room. Patent 1478922. H. J. Smith, 908 E. 35th St., Brooklyn, N. Y.

MOP HEAD—Formed from metal jaws, attached to rotate from the mop handle. Patent 1478339. W. H. Jayne, 414 E. 23d St., New York, N. Y. (See Fig. 5.)

GLASS CUTTING FRAME—Which may be used upon a table or in a vertical position. Patent 1479748. M. L., E. J. and A. L. Shaw, Corinne, Utah. (See Fig. 6.)

BELT—For carrying bait, leaders, a knife, and other necessary articles for use in fishing. Patent 1478497. R. W. Welch, Kelso, Wash.

EGG BOILER—Which may be set to time eggs, and raise them when boiled. Patent 1478939. R. J. Cavilla, 1124 E. 179th St., Bronx, N. Y.

RAPID TOWEL HANGER—With spring jaws for holding the towel corner. Patent 1478,911. F. Philippe, Sr., Box 3, South Charleston, W. Va.

EXPOSURE METER — For indicating the proper duration of photographic exposures. Patent 1478956. E. Harrold, Letonia, Ohio.

PROCESS OF PREPARING DRY AND SOLUBLE EXTRACT OF ROASTED COFFEE—Which contains without appreciable loss the total soluble principals of the coffee. Patent 1478,940. A. Chalas, 14 Rue Angelique Verien, Neuilly, France.

UNIT DRIER—For drying materials which have been subjected to a coating operation, such as wall paper. Patent 1478938. L. B. Case, c/o Standard Wall Paper Co., Hudson Falls, N. Y.

Hardware and Tools

RAKE—In which the clearing of the tines by hand is done away with. Patent 1471964. R. E. Leas, Luverne, Minn.

REHEATING DEVICE FOR SOLDERING IRONS—Which can be safely moved in any direction, and which includes a combustion chamber. Patent 1472729. J. E. Malivert, 11 Rue du Telegraphe, Paris, France.

ICE CREAM DIPPER—Requiring but slight muscular exertion in its operation for dispensing portions of the cream. Patent 1472533. W. R. Ripley, Sherman, Calif.

METAL WORKING TOOL—That will ream two or more holes in accurate alinement. Patent 1473245. F. P. Miller, c/o McCrosky Tool Corp., Meadville, Pa.

RIVET—Having a split shank, for use in connecting thin metal plates. Patent 1473137. N. Zierten, 64 Adams St., Albany, Calif.

WEIGHTED SCRAPER—So constructed as to be particularly useful in cleaning heavily coated surfaces. Patent 1473546. W. Eiermann, 1917 Fulton St., Brooklyn, N. Y.

REAMER—Which is so constructed that the cutting edge is maintained for a long period, and a smooth hole produced. Patent 1475311. F. P. Miller, c/o McCrosky Tool Co., Meadville, Pa.

LOCKING DEVICE FOR PLUGS—Designed for use with grease plugs and oil cup covers. Patent 1474239. G. S. Collins, 676 N. Main St., Meadville, Pa.

OIL WELL TOOL—For removing broken pieces of steel, or the like, from the bottom of a well. Patent 1475456. W. P. Stampfli, Box 784, Healdton, Okla.

WRENCH—Adapted for use as a twin wrench in connecting sectional drill stems used in wells. Patent 1476341. G. F. and F. L. Le Bus, c/o Le Bus Rotary Tool Works, Electra, Texas.

LATHE—Especially adapted for use in refacing the valves of internal combustion engines. Patent 1477102. N. F. Brasacchio, c/o A. F. Indrieri, Atty., Gary, Ind.

TOOL HOLDER—With means for adjusting the cutting tool on a lathe. Patent 1478967. S. A. Lee, Hudson Falls, N. Y.

DRILL—Which is especially adapted for cutting metal. The inventor has been granted two patents of a similar nature. Patents 1478623 and 1478624. F. H. Valiton, c/o Branscombe & O'Neill, Deer Lodge, Mont.

Heating and Lighting

COLLAPSIBLE STOVE — Especially adapted for use in camping, occupying but small space when packed for transportation. Patent 1473523. N. H. Smith, c/o Smith's Garage, Spring Valley, Ill.

OIL BURNER—Which is adapted to heat a furnace and which operates noiselessly. Patent 1473511. J. E. Pearson, 257 E. Delaware Place, Chicago, Ill.

GAS STOVE—Designed for use as a heater, the flame being controlled by openings in the combustion tubes. Patent 1477505. J. P. Lane, 171 Clinton St., New York, N. Y. (See Fig. 7.)

IGNITER FOR GASEOUS-FUEL BURNERS—Adapted to operate in connection with an electric lamp socket. Patent 1476725. H. C. Pope and J. H. Fieldhouse, address S. B. Smith, 526 Bryson Blk., Los Angeles, Cal.

WATER FEED FOR STEAM BOILERS—For embodiment in a heating system, for returning the water of condensation. Patent 1477472. W. A. Whitmore, Nelsonville, Ohio.

Machines and Mechanical Devices

COUNTER MOLDING MACHINE—For forming articles, such as the counters of footwear, from flat blanks. Patent 1471261. S. J. Heath, c/o Endicott Johnson Co., Johnson City, N. Y.

TOASTER—Adapted for use in places where large quantities of toasted bread are necessary. Patent 1471275. E. J. Moneuse, 108 W. 22d St., New York, N. Y.

REVOLVING SHUTTER FOR MOVING PICTURE PROJECTING MACHINE—Which increases the amount of light reaching the screen and eliminates the flicker. Patent 1471031. G. Johnston, 208 No. Lauret St., Richmond, Va.

FLUID PRESSURE LIQUID PUMPING DEVICE—Primarily designed for pumping water out of mines. Patent 1470973. W. J. Hancock, Idaho Springs, Colo.

PICTURE ATTACHMENT FOR TALKING MACHINES—Whereby a picture may be reproduced at or near the sound amplifier. Patent 1468547. R. A. Rummel, 567 Ryerson Ave., Woodridge, N. J.

MACHINE FOR CUTTING AND STRIPPING CANE—Which will cut the standing cane, remove the heads, and strip the stalk. Patent 1468195. F. S. Curbelo, c/o E. M. Amores, c/o Pan-Am. Union, Washington, D. C.

CLOTH-MARKING DEVICE—By means of which a plurality of layers of cloth may be marked in one operation. Patent 1468184. W. Webber, 612 Saratoga Ave., Brooklyn, N. Y.

BELT CUTTING AND TRIMMING MACHINE—Which will cut or trim a belt, strap or the like. Patent 1469154. J. T. Davison, 46 Holland Ave., Westfield, Mass.

EGG BEATER AND MIXER—For beating eggs, coatings, frostings, cake-doughs or mayonnaise. Patent 1468826. A. W. Minney, 2330 Glenarm Place, Denver, Colo.

REVERSING MECHANISM FOR RECIPROCATING MEMBERS—For reversing the direction of a reciprocating member at predetermined points along its line of travel. Patent 1468896. Wm. Barker, 5908 86th St., Portland, Ore.

FAN—With mechanism for effecting the oscillation and to vary the length of the arc. Patent 1468690. M. M. Glasser, Glasser Mfg. Co., Exchange and Preolean Sts., Charleston, S. C.

TENSIONING DEVICE FOR CLOTH FOLDING MACHINES—To facilitate the folding of cloth upon a cutting table. Patent 1469728. W. P. Levy, Spreckel, Calif..

FLOWING DEVICE FOR OIL WELLS—Which may be readily adjusted for use under a variety of conditions. Patent 1470053. A. Boynton, 1800 San Pedro Ave., San Antonio, Texas.

GRINDING BAR—For use in connection with lathes and other suitable machinery. Patent 1470164. J. R. Halterman, Box 2272, DeSoto Sta., Memphis, Tenn.

PORTABLE GRINDING MACHINE—Especially adapted for grinding the cylinders of engines. Patent 1471412. R. W. Opfel, Cuero, Texas.

CABLE LUBRICATING DEVICE—For lubricating cable during movement. Patent 1471583. A. S. Andersen, c/o Andersen Dredging Co., West Palm Beach, Fla.

COKE DRAWING MACHINE—For taking coke out of the beehive ovens, and conveniently piling the coke. Patent 1472730. R. D. Martin, 718 1st National Bank Bldg., Fort Smith, Ark.

COMBINED PRESSURE REGULATING AND GOVERNING APPARATUS—Adapted to control a fluid under pressure. Patent 1472662. J. P. Metzger, c/o The Leslie Co., Lyndhurst, N. J.

COMBINED EGG CANDLING AND ASSEMBLING DEVICE—By means of which a plurality of eggs may be candled and deposited into the case. Patent 1472673. W. G. Reagan, Lebanon, Ind.

CLUTCH—Of the ring expanding type which makes use of centrifugal force in effecting engagement. Patent 1472710. A. H. Wilson, 1118 So. Home Ave., Oak Park, Ill.

CREAM SEPARATOR—Whereby the richness of the cream may be readily regulated. Patent 1472085. P. C. Philip, Bowlus, Minn.

COLLAPSIBLE SOCKET—Adapted for use in removing various objects from wells. Patent 1472714. C. H. Brown, c/o Brown Welding & Machine Co., Breckenridge, Texas.

FARE COLLECTING DEVICE—For use in one-man street car operating systems. Patent 1472937. J. W. Pope, 1632 McLemore Ave., Memphis, Tenn.

MULTIPLE MITERING ATTACHMENT—For mitering machines, whereby a number of printers' rules may be mitered at the same time. Patent 1473521. H. B. Rubin, 972 Sherman Ave., Bronx, N. Y.

AUTOMATIC STOP FOR TALKING MACHINES—Which will operate when the sound box has been moved to an inoperative position. Patent 1473503. K. Nalbantian, 25 East Kingsbridge Rd., Bronx, N. Y.

GRINDING MACHINE—For grinding and dressing the surface of metal parts. Patent 1474321. P. De Mattia, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N. Y.

WIRE BINDING DEVICE—For use in binding rubber hose to a pipe or fastening mop head. Patent 1474265. D. Kenner, 8304 Fig St., New Orleans, La.

ADJUSTABLE PLATFORM—That may be used to raise and lower work to a convenient height. Patent 1474249. J. Ferrero, P. O. Box 254, Angels Camp, Calif.

CENTRIFUGAL PUMP—Which requires substantially the same amount of power to drive it at varying heads. Patent 1473904. W. C. Dowd, c/o Dayton-Dowd Co., Quincy, Ill.

ELEVATOR FOR STAIRWAYS—Adapted to be installed on any ordinary stairway, and not obstruct its regular use. Patent 1473813. C. C. Crispen, 708 No. 17th St., Harrisburg, Pa.

STITCH WHEEL FOR KNITTING MACHINES—The use of which permits of the formation of larger loops. Patent 1475045. J. Bloom, 4014 Park Ave., New York, N. Y.

PROCESS AND MEANS FOR PLUCKING POULTRY—Which is adapted to remove all of the feathers from a fowl in a single operation. Patent 1474702. G. W. Atkinson, Emerald, Idaho.

SAND BUCKET—For removing sand, rock, or loose obstructions from a well casing. Patent 1474707. M. L. Crowl, 1008 E. Orman Ave., Pueblo, Colo.

COIN DISPENSING DEVICE—Which may be readily changed from a "payer" to a "changer," without altering the operating mechanism. Patent 1475585. W. G. King, 1150 No. Blvd., Oak Park, Ill.

STOP MOTION FOR SPINNING FRAMES—With mechanism for preventing the overfilling of the bobbins. Patent 1475220. J. W. Cauthen, 626 Ridge Ave., Kannapolis, N. C.

VALVE ACTUATING MECHANISM—Whereby fluid valves may be operated without the use of projecting heads. Patent 1477419. A. G. Bertram, Cochem Ave. and 36th St., Flushing, N. Y. (See Fig. 8.)

STILE HORNING MACHINE—For horning or giving a reversely curved shaping to an end of a window stile. Patent 1476666. J. T. Williams, 2010 So. Alameda St., Los Angeles, Calif.

COTTON CLEANER—Which breaks the mass of cotton into small lumps, separating the seeds and trash from the cotton. Patent 1476010. E. P. Taft and G. Barton, c/o J. P. King Mfg. Co., Augusta, Ga.

AUTOMATIC STOP FOR MOTION PICTURE MACHINES—Whereby the motor unwinding the film will be automatically brought to a stop upon the film breaking. Patent 1476,006. M. E. Phimister, c/o Colonial Theater, Green Bay, Wis.

LOOP SEWING MACHINE—Particularly intended for joining knitted fabrics, and knitted parts of wearing apparel. Patent 1476658. A. L. Traver, Philmont, N. Y.

GUIDE AND ADJUSTER FOR LOOPER NEEDLES—Used in looper machines employed to join together knit fabric. Patent 1476659. A. L. Traver, Philmont, N. Y.

PHOTOGRAPH PRINTING MACHINE—Designed to decrease the time of printing operation, the print when fully exposed being dis-

charged on the application of a new sensitized sheet. Patent 1476574. P. Andersson, 82 Franklin Ave., New Rochelle, N. Y.

LUBRICATING DEVICE FOR WINDMILLS—Which automatically lubricates the various bearings and moving parts. Patent 1477519. O. Olsson, Ord, Neb.

MACHINE FOR SHAPING AND FORMING FABRIC CASES—Such as those containing musical instruments, whereby the fabric may be stretched over a die. Patent 1477437. J. Gaynor, 251 Washington St., Jersey City, N. J.

GATE AND BARRIER CONTROL MECHANISM—For use in self-service stores, to predetermine the course of a customer. Patent 1477493. M. R. Hutchison, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N. Y.

YARD METER FOR HEMSTITCHING MACHINES—For accurately measuring and registering the linear yards of goods, passing through the machine. Patent 1477049. L. N. Faubion, 328 So. Monroe Ave., Kansas City, Mo.

ECCENTRIC—That is of sectional type and may be applied to a shaft or axle without disturbing the latter. Patent 1477521. E. D. Richards, Ferriday, La.

WELL DRILLING APPARATUS—Applicable to any type of rotary machine used for prospecting subterranean strata. Patent 1477,563. H. C. Hirschfeld and R. S. Mayer, 500 H St., N. E., Linton, Ind.

DEVICE FOR OPENING AND CLOSING SLIDING DOORS—Particularly applicable to steel freight car doors. Patent 1478326. W. J. Dooley, 551 W. 174th St., New York, N. Y.

CANE-CUTTING APPARATUS TRANSMISSION GEAR—Adapted to be secured across the forward end frame members of an automobile. Patent 1478327. A. W. Dunn and G. Potter, 5540 Foothill Blvd., Oakland, Cal.

BUCKET FOR STEAM SHOVELS OR THE LIKE—Having a drop door as a bottom which closes automatically. Patent 1478301. W. C. Shea, 6231 Echo St., Los Angeles, Cal.

LOWERING AND RAISING DRUM FOR LIFEBOATS—Adapted to be operated by one person in either raising or lowering a boat. Patent 1477529. S. E. Allbin, c/o Mayer Life Boat Co., Seattle, Wash.

TUBE SUPPORT FOR DEEP-WELL PUMPS—Which may be quickly dislodged when necessary. Patent 1477714. J. Penrod and R. D. Thompson, 1241 E. 9th St., Okmulgee, Okla.

APPARATUS FOR CALCINING LITHOPONE—Which will eliminate or control the formation of zinc oxide as desired. Patent 1478,347. J. L. Mitchell, 17 W. 108th St., New York, N. Y.

FEED MIXING DEVICE—For the thorough mixing of grains or other feed. Patent 1477586. C. T. Patterson, R. No. 4, Springfield, Mo.

CLAY PIGEON TRAP—Which will automatically change the angle of departure of successive targets. Patent 1477942. C. O. Carothers, Kenton, Ohio.

TOOTHLESS SLIP AND ELEVATOR—Adapted for use in connection with oil, gas and water wells. Patent 1477709. J. E. Le Bus, c/o Le Bus Rotary Tool Co., Electra, Texas.

MACHINE FOR CASTING STEREOTYPE PLATES, and the like. Patent 1478935. C. Winkler, Berne, Switzerland.

Medical Devices

OPERATING TABLE—On which the patient may occupy a horizontal position, a sitting position, or a position between the two. Patent 1475143. O. B. Schillberg, Ritz Chambers, 48th St. & Madison Ave., New York, N. Y.

Prime Movers and Their Accessories

VALVE FOR INTERNAL COMBUSTION ENGINES—Which assists in breaking up the particles of fuel. Patent 1471955. R. P. Grieve, Lorraine Court, 501 No. Grand Ave., Enid, Okla.

ROTARY ENGINE—Whereby the supply of fluid under pressure to the expansion chambers or cylinders is automatically controlled. Patent 1473249. F. G. O'Rourke, Box 151, Blarsdell, N. Y.

CLEANING IMPLEMENT—Adapted for use in connection with the cleaning of carbon from spark plugs. Patent 1475118. G. A. Hoyem, Lennep, Mont.

SPARK PLUG—Which will have a downward pitch when used in valve-in-head motors having spark plugs set horizontally. Patent 1476350. L. F. Reynolds and J. S. Stewart, c/o J. Stewart, Mound City, Mo.

FIRE EXTINGUISHER—For automobiles, or other devices using internal combustion engines. Patent 1476594. C. A. Conover, 54 Leroy Place, Newburgh, N. Y.

LOCOMOTIVE SUPERHEATER — Permitting the feeding of superheated steam to the steam-receiving appurtenances and instrumentalities. Patent 1476150. M. M. Crowley, 915 12th St., Sioux City, Iowa.

ROTARY ENGINE—Rotated under the expansive force of steam, compressed air, or the like. Patent 1478352. G. Pagonis, 5 Columbus Circle, New York, N. Y.

MISS DETECTOR FOR INTERNAL-COMBUSTION ENGINES—With means for indicating to the operator the particular cylinder which is misfiring. Patent 1477732. F. H. Valiton, Box 220, Deer Lodge, Mont.

AIR-MIXING DEVICE—With means for regulating the flow of air, according to the speed of the engine. Patent 1477988. H. Wehr and J. G. Pineau, 9209 78th St., Woodhaven, N. Y.

PISTON—For internal combustion engines, with means for varying its size to compensate for wear. Patent 1478963. R. C. Jones, Jefferson, N. Y.

Railways and Their Accessories

TROLLEY LOCK—By means of which the trolley wire may be retained in proper relation to the trolley wheel. Patent 1473567. W. M. Laue, 16 Harlar St., Glens Falls, N. Y.

BULL BOARD FOR CATTLE CARS—Consisting of a bar across the inside of the doorway, to keep the cattle from the opening. Patent 1473494. F. S. Miely, Gentry, Ark.

TROLLEY SHEAVE—For the purpose of supplying current from the trolley wire to the motor of a car. Patent 1474241. J. J. Crapper, 407 2d St., Brooklyn, N. Y.

RAILWAY TIE AND RAIL FASTENING—Constructed of a cementitious material, which will take the place of wooden ties. Patent 1475106. J. F. Balme, Jr., 755 Tremont St., Boston, Mass.

GUARD AND SIGNAL FOR RAILWAYS, ETC.—To afford warning and offer a barrier to the passage of a vehicle. Patent 1477438. A. T. Gookin, 9 Brattle St., Cambridge, Mass.

SAFETY DEVICE FOR RAILWAYS—Adapted to prevent trains from running into one another. Patent 1477486. M. K. Healy, 2612 Ave. I, Brooklyn, N. Y.

TRAIN CONTROL SYSTEM—Which automatically stops the train, in the event the engineer fails to observe the signal. Patent 1478273. I. A. and J. C. Call, 5 Beekman St., New York, N. Y.

Pertaining to Recreation

TOY—By means of which an arrow may be projected into the air. Patent 1468223. U. Baltich, 841 Maryland St., Gary, Ind.

EDUCATIONAL TOY—Which will develop the artistic facilities, while demonstrating a comparison of size. Patent 1475112. W. N. Grimes and J. Muenzmay, 3316 Dawson St., Pittsburgh, Pa.

TOY—Simulating the movements of an airplane when traveling on the ground. Patent 1475059. A. L. Erickson, Gen'l Delivery, Ketchikan, Territory of Alaska.

GAME—Adapted for use to afford entertainment and amusement to children. Patent 1474934. N. J. Jacobson, Box 291, Phillips, Wis.

GAME APPLIANCE—By which the hand of a player will be prevented from being bruised or injured. Patent 1477460. H. B. Smith, 139 Lefferts Place, Brooklyn, N. Y.

Pertaining to Vehicles

RESILIENT VEHICLE WHEEL—Wherein provision is made for excluding the entry of foreign matter such as mud. Patent 1470,071. A. B. Fuhr, Macomb, Ill.

STRAINER—Particularly for use in draining gasoline before it enters the pipe line. Patent 1471293. C. H. Sturgis, c/o B. F. Berry Coal Co., Granville, Ill.

LIQUID RESERVE DEVICE—Adapted for use in connection with the outlet of a gasoline tank. Patent 1469947. R. E. Mudd, 715 E. 61st St., Chicago, Ill.

CHAIN CONNECTOR—Particularly constructed for fastening the opposite ends of a tire chain. Patent 1469164. E. N. Malvern, Burlington Junction, Mo.

BRAKE FOR SELF-PROPELLING VEHICLES—Actuated by a fluid for partially or wholly stopping rotation of the drive shaft. Patent 1470192. F. H. Ricker, 1711 Scott Ave., Los Angeles, Calif.

HOLDER FOR MAGNETO CONTACTS—For securing the contact and binding post in proper position upon the crank-case. Patent 1470993. L. A. Loundagin, c/o Harvey Valley Trans. Co., Crane, Oregon.

DETACHABLE TIRE CARRIER—Which may be used for carrying a second spare tire. Patent 1471268. W. E. Kelly, 1176 Williams Ave., Portland, Oregon.

AUTOMATIC INFLATING DEVICE — Constructed to automatically control the supply of fluid under pressure to tires. Patent 1469201. H. F. Whitted and F. G. Schulze, Santa Paula, Calif.

VEHICLE TIRE—The tread of which will not readily become punctured. Patent 1471949. J. T. Doranski, 11347 Watt Ave., Chicago, Ill.

AUTO LIFT—Which may be operated with the least amount of energy. Patent 1471695. E. H. Kelley and G. A. Stewart, Jr., 728 Water St., South Brownsville, Pa.

TIRE MILEAGE INDICATOR—Capable of attachment to a tire shoe. Patent 1471981. A. G. Sargent, 39 Center St., New Haven, Conn.

DIFFERENTIAL—In which all of the parts may be bodily removed from the rear axle housing. Patent 1471915. V. W. Page, c/o Victor Page Motor Co., Melrose Ave., Stamford, Conn.

AUTOMOBILE STEP—Which will replace the well-known running board. Patent 1471972. H. D. Miller, Box 6, Lawton, Okla.

DIRECTION INDICATOR FOR MOTOR VEHICLES—Which is visible by day or night, and operable from the steering wheel of the vehicle. Patent 1472186. C. E. Morris, Grimes, Calif.

BRAKE STRUCTURE—Pertaining more particularly to internal brakes. Patent 1471914. V. W. Page, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn.

TIMER—Of simple construction, especially intended for use on Ford cars. Patent 1472180. H. G. Lorenson, Box 63, Newman, Calif.

AUTOMOBILE IDENTIFICATION DEVICE—Which can be readily applied to any car, whereby the owner or operator may be readily identified. Patent 1473556. M. IAFRATE, Box 151, Shansokni, Pa.

AUTOMOBILE LOCK—By which the control pedals are held in an inoperative position. Patent 1473469. C. Cynamon, 530 W. 163d St., New York, N. Y.

CLUTCH—For connecting a driving shaft with a driven shaft. Patent 1473564. J. Klepper and C. Klepper, 10-12 2nd Ave., New York, N. Y.

AUTOMOBILE TOOL—For replacing transmission covers on Ford cars. Patent 1473114. M. McIntyre, 139 Center St., Healdsburg, Calif.

CLUTCH LEVER ATTACHMENT FOR TRACTORS—For throwing the clutch in or out and applying and releasing the brake. Patent 1473466. L. Conboy, c/o C. V. Henderson, Asquith, Saskatchewan, Canada.

TOOL BOX—Which may be readily applied to the running board of an automobile. Patent 1473319. S. P. Ray, Urich, Missouri.

CLOTHES CONTAINER—Which is accessible through the top of the body of an automobile at the rear seat. Patent 1473161. V. B. Rogers, Star Route "A," Canutillo, Texas.

COMBINED VEHICLE FENDER AND BUMPER—Which will serve as a means for fending off or picking up pedestrians. Patent 1474263. W. Jaeger, 902 Willow Ave., Hoboken, N. J.

PEDAL PAD—For preventing the foot from slipping from the face of a pedal. Patent 1474320. B. De Mattia, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N. Y.

FOLDING STEP—Adapted to be operatively applied to an automobile or like vehicle. Patent 1473858. S. Koeberlin, Fremont, Neb.

LOCKING DEVICE AND ALARM FOR AUTOMOBILES—Which renders the ignition system inoperative, and sounds an alarm if tampered with. Patent 1474262. F. Hoyt and C. F. Holmes, 53 Pleasant St., Newburyport, Mass.

BRAKE APPARATUS FOR MOTOR VEHICLES—By means of which the wheels may be retarded, in variable degrees or locked against rotation. Patent 1476170. F. H. Morlan, The Stillwell, between 8th and 9th on Grand Ave., Los Angeles, Cal.

COMPOUND FOR POLISHES—For use with automobiles, wood and metal work of every character. Patent 1473947. T. Bailey, c/o O. Waldkirch, Morgan & Hamilton Co., Nashville, Tenn.

COLLAPSIBLE CORE—Such as are used in the manufacture of pneumatic tires, more particularly the casings. Patent 1475109. P. De Mattia, c/o Munn, Anderson & Munn, Woolworth Bldg., New York.

AUTOMATIC GEAR SHIFT AND SPEED CONTROL—In which the manual shifting of the speed gear is obviated. Patent 1475265. H. R. Hoffman, 2069 Humboldt Blvd., Chicago, Ill.

DIRECTION SIGNAL — Located near the steering wheel of a car and within easy reach of the operator. Patent 1476616. W. A. Jacobus, R. R. No. 2, Box 42, Wood River, Neb.

AUTOMOBILE SCREEN—For preventing flying bugs or insects from striking the operator, or occupants of the car. Patent 1476,336. V. D. Hitchings, 538 Front St., Norfolk, Va.

AUTOMOBILE SPRING REGULATOR—Adapted for use in connection with the spring suspension to cushion their action. Patent 1477433. W. C. Engel, Ashland, Pa.

UNCHANGEABLE MOTOR NUMBER—So connected with part of the engine that it cannot be changed or removed without detection. Patent 1477466. L. P. Terhaar, 256 W. 84th St., New York, N. Y.

RESILIENT TIRE FOR VEHICLE WHEELS—Comprising a chambered body, a plurality of fibers enclosed thereby, and an annular air chamber. Patent 1477518. C. Noel, 35 Rue Gravel, Levallois, Perret, France.

MOTOR VEHICLE SUSPENSION—Composed of a half-elliptic main spring, and a quarter-elliptic supplementary spring. Patent 1477,477. O. R. Dunnet, Charra, West Coast, South Australia, Australia.

BUMPER FOR VEHICLES—Adapted to hold characters which supply information, as well as serving as a bumper. Patent 1477067. J. C. Lawson, 351 E. 1st St., Los Angeles, Cal.

AUTOMOBILE DIRECTION INDICATOR — In which the signal arm is illuminated upon reaching an extended position. Patent 1478007. F. O. Gray, Box 330, Crystal Lake City, Ill.

TAPE FOR WHEELS—For holding a wheel in position during the installation of the hub, or repair. Patent 1477975. J. Olson, cor. 7th and D Sts., Lewiston, Idaho.

SHOCK ABSORBER—Wherein the springs will absorb both major and minor shocks. Patent 1477791. E. A. Traver, c/o Geo. Jensen, Thornton, Cal.

CIRCUIT CONTROLLER—Adapted for use in connection with signalling systems on automobiles. Patent 1477917. F. M. Smith, 320 No. 6th St., Corvallis, Ore.

CLUTCH BAND—For use in connection with Ford transmission. Patent 1477577. J. Malligan and C. R. Lytle, Point Marion, Pa.

Designs

DESIGN FOR A BOTTLE—Patent 62804. H. K. Quan, 26 Pell St., New York, N. Y.

DESIGN FOR A RING—Patent 62922. J. Simmons, 137 W. 64th St., New York, N. Y.

DESIGN FOR A CANDLE—Patent 63032. A. E. Glistridis, 1450 E. 95th St., Brooklyn, N. Y.

DESIGN FOR A TIRE TREAD—Patent 63051. B. Gottlieb, 73 West Broadway, New York, N. Y.

DESIGN FOR A LIGHTING FIXTURE ARM. Patent 63191. A. Miller, c/o Radiant Lighting Fixture Co., 33 Bleecker St., New York, N. Y.

DESIGN FOR A WOVEN FABRIC. Patent 63196. F. Reeves, c/o Gardner Textile Co., 35 White St., New York, N. Y.

DESIGN FOR A HAND BAG. Patent 63138. M. Miller and M. L. Kurtz, c/o Murray Miller, 52 W. 46th St., New York, N. Y.

DESIGN FOR A BUILDING TILE. Patent 63233. Q. Monier, P. O. 411, Tucson, Ariz.

DESIGN FOR A FINGER RING. Patent 63280. H. Breslavsky, 64 Fulton St., New York, N. Y.

DESIGN FOR A GAME BOARD. Patent 63366. J. W. Hanley, 204 E. 51st St., New York, N. Y.

DESIGN FOR A LIGHTING FIXTURE ARM. Patent 63658. I. Rosenblatt, c/o Globe Lighting and Fixture Co., 134 Mott St., New York, N. Y.

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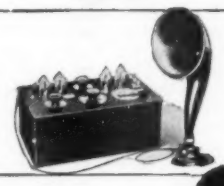	**Radiola III-A** with four WD-11 Radiotrons,* head telephones and Radiola Loudspeaker.	$100	Loudspeaker operation up to 1500 miles under favorable conditions.	Outdoor or indoor antenna.	Improved selectivity. Minimum radiation.
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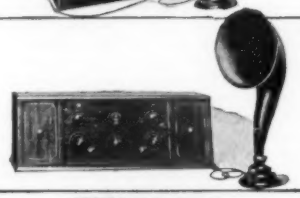
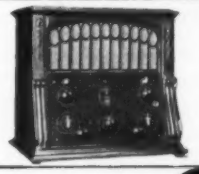
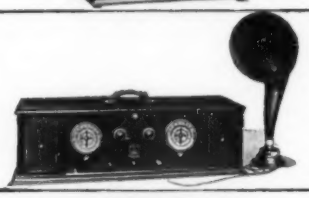
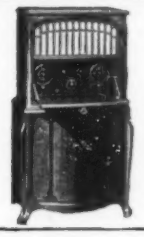
	**Radiola Regenoflex** with four WD-11 Radiotrons,* and Radiola Loudspeaker.	$206	Loudspeaker operation up to 2000 miles under favorable conditions.	Outdoor or indoor antenna.	Extraordinary selectivity. Non-radiating.
	Same without Radiotrons or Loudspeaker.	$150			
	**Radiola X** with four WD-11 Radiotrons.* Loudspeaker built-in.	$245	Loudspeaker operation up to 2000 miles under favorable conditions.	Outdoor or indoor antenna.	Extraordinary selectivity Non-radiating.
	**Radiola Super-Heterodyne** with six UV-199 Radiotrons* and Radiola Loudspeaker.	$286	Loudspeaker operation up to 2000 miles with internal loop. With external loop up to 3000 miles under favorable conditions.	No antenna. (Concealed small loop built into set.)	Super-selectivity. Non-radiating
	Same without Radiotrons or Loudspeaker.	$220			
	**Radiola Super-VIII** with six UV-199 Radiotrons.* Loudspeaker is built-in.	$425	Loudspeaker operation up to 3000 miles under favorable conditions.	No antenna. (Concealed large loop built into set.)	Super-selectivity. Non-radiating.

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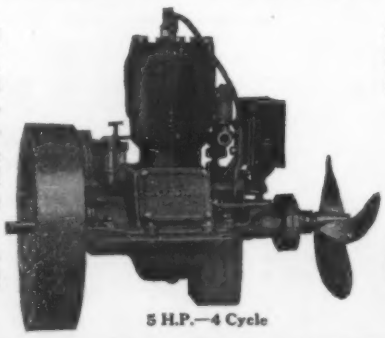

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A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests appear elsewhere in this issue

Automotive

Unique Tests on Wheel Slip were made by *The Autocar* (see No. 1,474) in an effort to determine exactly what the rear wheels do in various circumstances. Use was made of a device which shows accurately the number of revolutions or parts of a revolution, made by either of the rear wheels relative to the other. A most interesting point became apparent, as independent of the action of the differential when the car was taking curves or corners there was a continuous movement due to the difference in size of the two tires. This is due chiefly to difference in inflation, and imposes a constant extra duty on the differential. The continuation of the test brought to light the fact that whereas the average motorist would assert that he knows of a considerable number of bad roads which would certainly make the wheel slip, yet experience with this instrument proved that it was exceptionally difficult to find a road sufficiently bad to cause any slip at all, the ordinary bumpy road having no effect whatsoever on a light car. With a heavy car, wheel slip on a road with many pot holes was quite common, though it is almost impossible for the crew of the car to tell what is happening.

The Balloon Tire will probably have a greater effect on the design of the motor car than is at first thought apparent. Whatever the immediate effects on the tire industry may be, a new impetus will be given ultimately to the whole motor car business by the advent of balloon tires, assuming that they are an undoubted success. The additional cushioning that the low-pressure gives the car will make it possible to redesign the whole chassis and perhaps reduce the weight of some cars by a fifth or more. Such a saving in materials should have a tendency further to lower prices. It may be found that four-wheel brakes have no particular advantages when balloon tires are used, because of the better traction they afford, with consequent increased braking efficiency and reduction of the tendency to skid. Also, the use of chains may be greatly curtailed. On the other hand, snubbers or shock absorbers may become almost universal if balloon tires generally accentuate the vertical oscillations of the body. Then there is a possibility that the better utilization of power by the balloon tires and the reduction of car weight will permit of smaller engines, with a resultant saving in fuel consumption. This all tends toward a lowering of the cost of motoring and a pushing of the much-discussed car saturation point further into the future.—*Ind. Rubber World*, 69:5; 2 pp.

Gasoline from Casing Head Gas.—At present there are two principal sources of gasoline. The refining of crude oil by distillation and "cracking" of the heavier distillates provide the larger part. A smaller amount is got by extraction from certain natural gases, particularly from that known as "casing head" gas. The rise in price and enormous consumption of gasoline within the last few years have caused more attention to be given to the extraction process and have made the method an attractive one, particularly in oil fields that heretofore could not be worked at a profit. The gasoline extraction process is a comparatively simple one, consisting essentially of compressing the gas and then cooling it. A gasoline extraction plant generally comprises one or more vacuum pumps, two-stage compressors of either the straight line or duplex type, coolers, accumulating tanks, blending tanks, gasoline traps, pipe fittings and some form of prime mover. The principal merit of the extraction process is that it opens up a field for the production of gasoline at moderate cost from sources unavailable previous to its development, and in some cases from gases which otherwise would go to waste. In fact it is authoritatively stated that the gasoline extraction process has made available for public use many millions of gallons of gasoline annually that otherwise would not be available.—*Can. Min. Jour.*, 45:4, 2 pp.

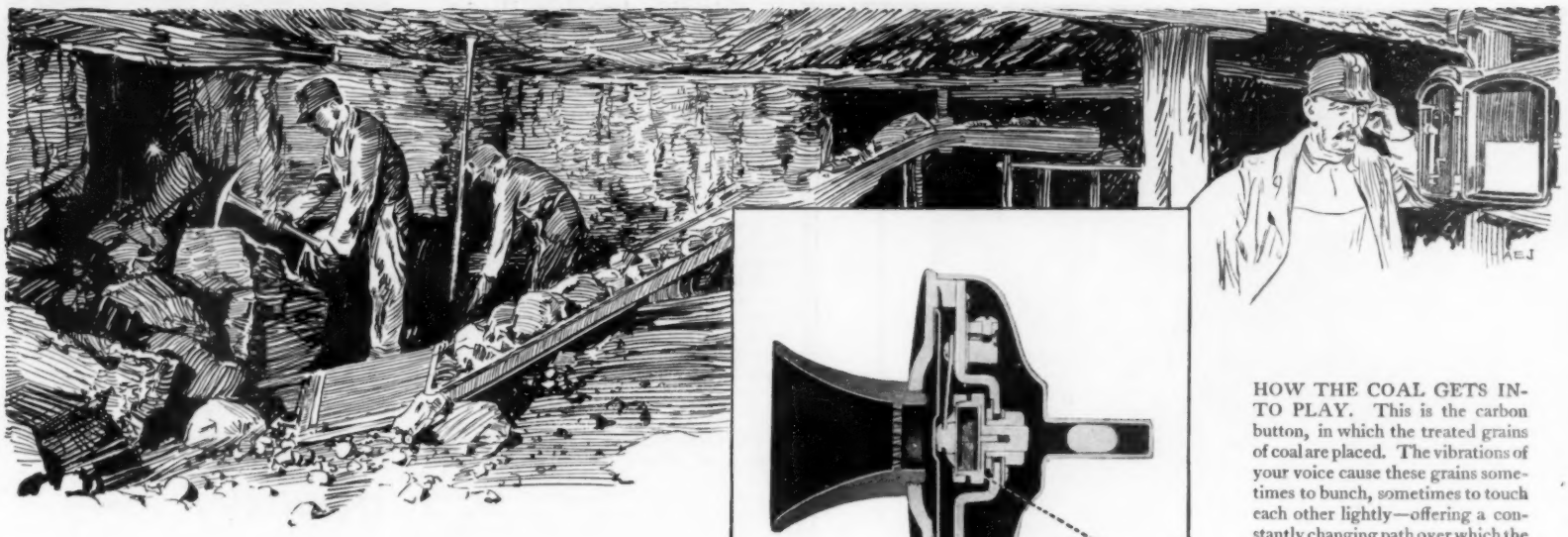
The Temperatures Required to Vaporize Present-day Fuel by means of the so-called hot-spot manifold, and the temperatures available in the exhaust under different running conditions, are the subjects of researches that have been carried out at Purdue University. Contrary to what might be expected, the tests showed the cooling water temperature to have little influence on the exhaust gas temperature. Increasing the cooling water temperature from 70 to 212 deg. Fahr. decreased the exhaust temperature less than 50 deg. It is concluded that the best cooling water temperature depends more upon lubrication than carburetion requirements. The exhaust temperature varies from a minimum of about 300 deg. to a maximum of nearly 1500 deg. Under normal operating conditions with a well designed manifold the temperatures are usually high enough to deal with a fuel somewhat less volatile than our present gasoline, whereas at low idling speeds the temperatures are hardly adequate for our present fuel, but as a result of the reserve heat in the manifold an engine can idle for about 15 min. before the temperature reaches a minimum. In practical operation the condition most difficult to meet is the sudden opening of the throttle after a long period of low speed idling. While idling the pressure in the inlet manifolds is very low, under which condition the fuel vaporizes at lower temperatures than at atmospheric pressure. In addition, during periods of idling the temperature of the metal of the spot drops to a minimum. Sudden opening of the throttle draws a large amount of fuel into the manifold at nearly atmospheric pressure, and these two conditions both demand additional heat and constitute the most severe conditions to which the manifold can be put.—*Automotive Eng.*, 50:3, 4 pp.

American Farm Tractors are still in the running abroad. Altogether, twenty-nine makes of tractors were exhibited at the autumn tractor trial at Essone-Corbeil, France. Of this number, eleven were American and the rest French, with the exception of three. The relative amount of interest displayed in the French and American makes indicated quite clearly that the French public are more than partial to the latter, says Assistant Trade Commissioner David S. Green in a report to the Commerce Department. With the exception of the new Citroen caterpillar tractor performances of the French models did not arouse much enthusiasm among the onlookers.—*Automotive Ind.*

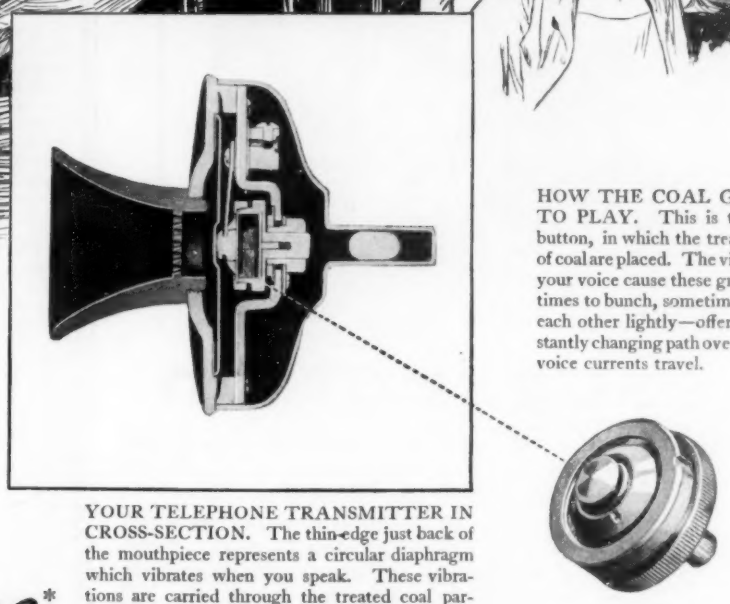
Do Mufflers Cause Power Loss?—Far less than is generally thought, says a writer in *The Autocar* (50:1473). Since 1914 engines of the higher efficiency type have undergone a considerable change, especially in the direction of increased piston speeds and, what follows as a natural corollary, increased speed in the flow of exhaust gases. Tests were made, using a four-cylinder motor, first with a plain pipe, and then with the standard form of silencer. A curve plotted from the two series of tests indicates not only that there is a negligibly detrimental effect introduced by quieting the exhaust, but that the actual horse-power delivered is greater with the silencer than without it at high speeds.

American Oil-Shale "Industry" Still Experimental.—No standard retorting or refining practice for oil shale and shale oil has yet been established in the United States according to Technical Paper 3244 Bureau of Mines. Many processes have been proposed, and perhaps 25 to 30 experimental or demonstration plants have been erected in different parts of the country. Practically without exception, however, these plants are too small to be considered as commercial, or to give operating data that would be of much value in estimating water requirements. The proposed retorts for treating oil shade may

(*Continued on page 268*)



HOW THE COAL GETS INTO PLAY. This is the carbon button, in which the treated grains of coal are placed. The vibrations of your voice cause these grains sometimes to bunch, sometimes to touch each other lightly—offering a constantly changing path over which the voice currents travel.



YOUR TELEPHONE TRANSMITTER IN CROSS-SECTION. The thin edge just back of the mouthpiece represents a circular diaphragm which vibrates when you speak. These vibrations are carried through the treated coal particles; thence as electric currents over the wires.

Coal
– *in your telephone**

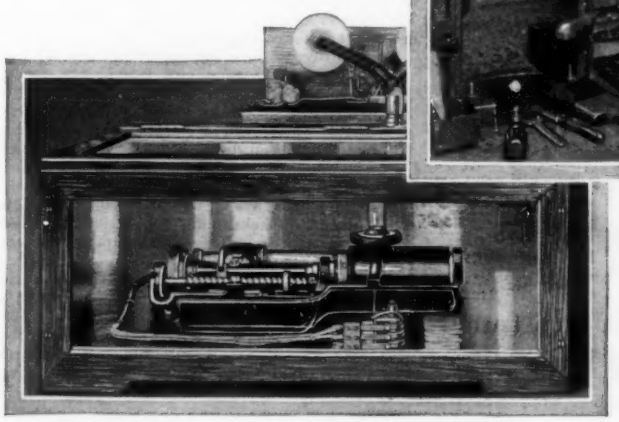
Coal, selected with painstaking care and subjected to a series of special treatments, becomes in the transmitter the very vocal chords of the telephone.

This treated coal offers a means of translating into electrical impulses the vibrations of the voice and even the inflections and mannerisms peculiar to any one voice.

Skill of a high order is essential in making the carbon button and indeed all of the 201 individual desk telephone parts. This craftsmanship has been a Western Electric standard ever since 1877.

*No. 7 of a series on raw materials.

WHERE EVERY GRAIN COUNTS. Weighing the grains of coal that go into the carbon button. Either too many or too few would interfere with voice transmission. A skilled operative, using a chemist's delicate balance, checks the amount which this button contains.



AND THEN A PHONOGRAPH TESTS IT. To make sure that the carbon button is filled right, and that the whole telephone transmitter has been properly assembled, life tests are made under actual voice conditions. Phonographs like this repeat the phrase, "1, 2, 3, 4, 5," many thousand times into the mouthpiece.

Western Electric

SINCE 1869 MAKERS OF ELECTRICAL EQUIPMENT

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Many a vessel, large and small, owes its new lease of life to the sheer strength of Yellow Strand Wire Rope.

Built for heavy duty, this powerful rope can always be depended upon to deliver a full and overflowing measure of unusual service. The *strand* of *yellow* is your protection.

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Carry a Basline Autowline in your car and safeguard your spare tire with Powersteel Autowlock. Both are made of Yellow Strand. Ask your accessory dealer.

When making wire rope requisitions, specify, "Broderick & Bascom manufacture." Then you'll know you'll get your money's worth.

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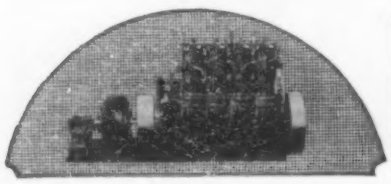

Power, Profits and Bessemer

TO meet the severe sales-competition of 1924 industrial plants must operate with maximum economy. The power source offers amazing profit possibilities—if you are now using steam.

Efficient oil burning engines are not only more economical as regards fuel, but in maintenance cost, space saving, operating expense and efficiency there is no equal to a Bessemer oil burning engine (except in a few rare cases of water power).

Perhaps you require but 15 H. P., perhaps a thousand H. P.—whatever your need may be there is a Bessemer engine that will pay power plant profits.

Our engineers will be glad to go into your problems with you and advise you without obligation. Write or wire for a representative or descriptive literature.

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9″ x 3′	$231.00	$201.00
11″ x 4′	278.00	238.00
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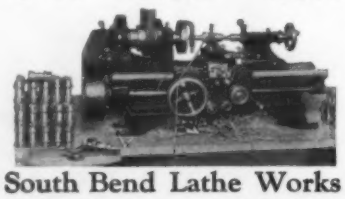

South Bend Lathe Works
421 E. Madison St. South Bend, Ind.

Scientific American Digest

(*Continued from page 266*)

be grouped in a general way under two heads: (1) Those in which dry destructive distillation takes place, and (2) those in which distillation progresses in the presence of superheated steam or gas. In the well-known Scottish type of retort, used for many years in Scotland, steam is used. Whether or not Scottish practice will be followed in this country remains to be seen, but as the Scottish plants are today the only ones operating on a large commercial scale, knowledge of their water requirements will be of value in estimating requirements for plants in the United States. If, later on, American retorts should be designed differently so that they use less water or none at all this development will in many cases be a point decidedly in their favor.

Electricity

Electrification of Farms in Sweden.—Abundant mountain streams make the distribution of electrical power to Swedish farms a comparatively simple matter. According to an article in *Elec. World* (83:4, 5 pp., ill.), at the end of the year 1921 more than 38 per cent of the arable land was electrified in a potential sense, at a cost of between 1½ and 2 per cent of the whole national fortune. A thorough investigation of the farmer's needs, of the possibility of cutting down the total cost of energy and of means to raise the money for local distributing networks has led to a plan that is now being adopted in large parts of the country. This method aims at the forming of local joint-interest unions among the farmers, under the terms of special legislation, one union embracing an area with a radius of about four miles. Every partner has to sign one share bond for about $5 per acre of his cultivated ground. He has, besides, to furnish a certain number of poles from his own property, haul materials and pay certain dues proportional to the number of his share bonds. Cultivating the soil by electrically driven tools is still a problem that is waiting for a satisfactory solution. Several methods have been tried. The latest (the Forsblads system) comprises a tractor with an electric motor and an armored cable that is coiled and uncoiled by a special device on the tractor, thus having a considerable radius of action. It seems to open new possibilities. Electric plows had previously been used in Sweden only experimentally. Electrical energy is also used for heating water for the cattle and in the dairy. Quite a new field is the electric conservation of fodder in silos.

A New Motor has been developed which combines the otherwise conflicting qualities of high efficiency, high torque, constant speed and high power factor. The plain induction motor has the inherent disadvantage of operating at a poor power factor. The squirrel-cage induction motor develops a very high torque if the resistance of its rotor windings is high, but under these conditions the motor operates at low efficiency. It is possible to raise the efficiency of the motor by lowering the rotor resistance, but when this is done a low starting torque results. Synchronous motors have the advantage of operating at constant speed but usually have low starting torque and low pull-in torque. To combine high efficiency, high torque characteristics, constant speed and high power factor a motor known as the Flynn-Weichsel motor has been developed. This is essentially a combination of the induction motor and synchronous motor. In addition, the revolving member has a winding which is essentially a synchronous-motor exciting field. These two windings are respectively connected to slip rings and a commutator mounted on the rotor shaft. The operation of the motor is such that it starts out as an induction motor and, therefore, has induction motor characteristics, comes up to synchronous speed and operates as a synchronous motor, and under very heavy loads pulls out of synchronism and again automatically becomes an induction motor with high pull-out torque.—*Coal Age*, 25:4, 1 p.

High-Frequency Telephone Communication on 140,000-volt lines between Jackson and Battle Creek, Mich., marks a distinct advance in the art. The basic advantage of the high-frequency telephone is the use of the power lines themselves as a communication circuit which, owing to its superior mechanical strength, affords a more reliable circuit than the usual telephone line. For distance exceeding 15 miles this system is cheaper to install and maintain than a wire line, and it has a most promising future for central-station use. The high-frequency

Does iron lower your product's quality?

THE slightest trace of iron in food, pottery, rubber, and chemical products is sufficient to materially lower their quality if not completely ruin them. Stray bits of iron—"tramp iron"—wreck crushing and grinding machinery. Dings Magnetic Pulleys remove every last trace of iron from ground and pulverized products during process—before it has a chance to spoil the product or harm the machinery.

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The Dings bulletins are free—write for them. They may be the means of pointing out a considerable saving for you.

Dings *High Intensity* **MAGNETIC SEPARATION**

See 'phone book for branches in New York, Denver, Richmond, Detroit, Chicago, Pittsburgh, Cleveland, St. Louis, El Paso, Birmingham, Los Angeles, Cincinnati, Salt Lake City, Portland, Ore.

Send the Coupon to

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—for instructions for sending sample for magnetic separation report and free bulletins.

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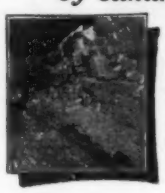
Att'n.....

Sc. Am. 4-24

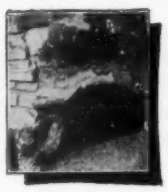
Make furnace walls last longer . . .

—by eliminating this!



If you have fire brick linings they go bad quickly once the joints—the weak spots—give way. Bricks crack; the wall bulges; relining is necessary. Eliminate this.

—and this!



Front door arches, too, soon need repairing if made of brick. Heat attacks the joints. The joints, then the bricks, go bad after only a few months of service. This, also, can be eliminated.

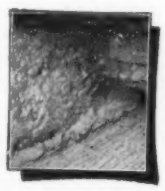
—install Plibrico!

Pounded in with mallet and trowel, it forms a jointless lining that outlasts fire brick two to four times. It has no joints. Withstands 3100 deg. F. Cuts down heat loss.

—anyone can do it!

You don't need skilled masons to install Plibrico. Any man about the plant can do it. A mallet,'a trowel and a desire to end furnace trouble are all that are needed.

—get walls like this!



This Plibrico wall at the Otis Bldg., Chicago, is four years old. Have you walls as old that are good for as much more service? You will have if, next time, you reline with Plibrico.

Plibrico is delivered only in steel containers of distinctive appearance as shown below. Stocks in principal cities.

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FURNACE LINING
Reg. U. S. Pat. Off.
JOINTLESS FIRE BRICK CO.
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Get your FREE copy

"Refractories and Furnace Design" will point the way to longer furnace life. Send the coupon for your copy.

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Firm .....

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Att'n .....

currents are superimposed on and received from the power lines by antennas strung on same towers as the transmission lines. The operation of calling is exactly the same as with a standard form of automatic telephone. For example, when the load dispatcher at Jackson desires to communicate with the station operator at Battle Creek, he merely lifts the receiver from the hook of his desk set and dials the number assigned to the Battle Creek station. The act of unhooking starts up the high-frequency telephone apparatus at the Jackson steam plant and sends out a series of modulated high-frequency impulses over the 140,000-volt power line. This impulse sequence is picked up by the receiving antenna at Battle Creek, where it is led through the high-frequency receiver and after being amplified actuates a pair of relay contacts which notch up a selector. If this selector pauses on the proper contact point, a circuit is completed through the station call bell, which then rings until the station operator unhooks and answers the call. The act of unhooking starts his high-frequency transmitter and enables him to communicate with the load dispatcher, just as though he were using a standard wire-line automatic telephone. It is to be particularly noted that the installation provides for the simultaneous two-way communication called duplex; that is, both parties are able to talk and listen at the same time, as is the case with the commercial wire-line telephone.—*Elec. World*, 82:25, 4 pp., ill.

A Great Hydroelectric Plant which needs no man about the place while it furnishes power to the industries of New England is located at Searsburg, Vt., on the upper waters of the Deerfield River. Excepting for the occasional visit of an engineer, it operates in complete solitude. It is wholly automatic in its control. If serious trouble arises in its mechanism, it shuts down and stays shut down until experts have made things right again. But if the trouble is trifling and of a sort to correct itself, the big waterwheel and generator rest for a time until conditions are again normal, and then start up again turning out their thousands of horse power. Its turbine, rotating at 360 revolutions per minute, drives a generator having a capacity of 6500 horse power. The only help from human beings that is required is an occasional looking over and attention to the lubricating system, and remedying of any trouble, or set the governor mechanism to produce a given amount of power, or to start up the turbine at some predetermined moment. If left to itself to run as it wants to, the turbine will start up when water arrives in sufficient volume, and will shut down when the water falls below the efficient limit. Should a bearing become heated the penstock gate closes, in which case the wheel will stay idle until experts come and remedy the trouble. But when generator windings become too warm, the unit shuts down only so long as the temperature remains abnormal. When the windings cool off, turbine and generator run along merrily again. In times of high water, when the river flow itself is ample and storage water is not a factor, the Searsburg plant runs right along all by itself, day and night, a constant, dependable source of power. It is here that another automatic function is important, the regulation of power generated to the load imposed. When the load falls off the action of the governor causes the supply of water to decrease proportionately, which means the production of a smaller amount of power.—*Science Service.*

General

Poor Germany?—Germany is steadily winning back her pre-war trade. An instance is given in an editorial in *Engineering* (No. 3028), where the import trade of South Africa comes under discussion. In 1919 the importation of goods from Germany only amounted to a few thousand pounds in value. This was increased to over one million pounds in 1921, and a further extension to over two and a-half millions was shown in 1922. The exports to Germany from South Africa—which, however, do not include any goods resold to Germany from the United Kingdom and other European countries—show similar expansion, and have reached the figure of 2,875,000*l*. For the same period American trade has suffered a decline. German competition has been shown most keenly in all classes of domestic ware. In the aluminum utensil market German goods account for five-sixths of the total trade, and somewhat similar characteristics are apparent in the trade in enamel ware. When the returns for agricultural machinery are reviewed it is apparent that German competi-

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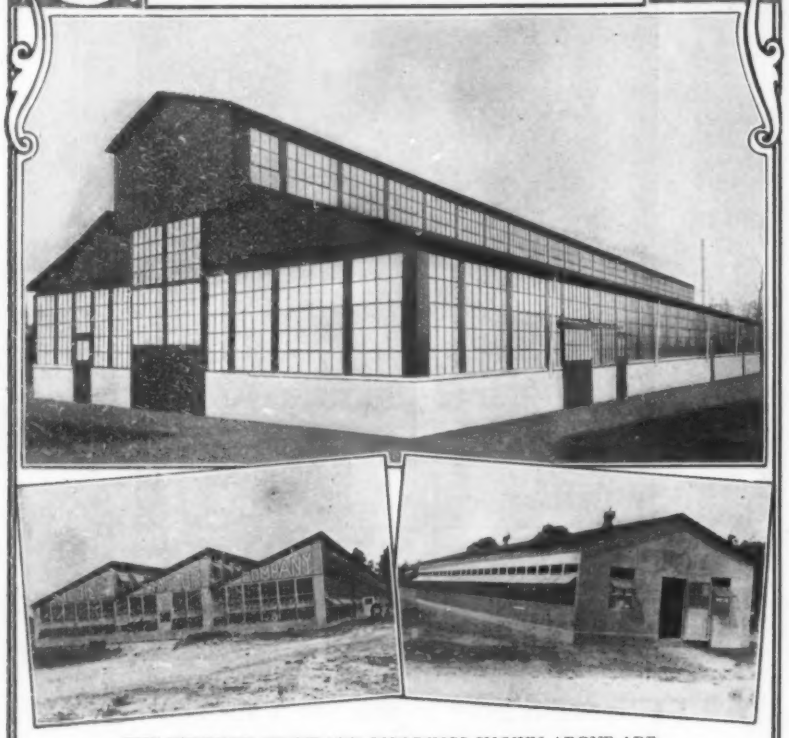

THE TRUSCON STANDARD BUILDINGS SHOWN ABOVE ARE

Top: Cincinnati Abbatoir Co., Norwood, Ohio. *Lower Left:* Mobile Tractor Co., Mobile, Ala. *Lower Right:* Applebee Pearl Button Co., San Juan, Porto Rico

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tion is keenest in the market for dairy utensils and ploughs. The old German position in fencing wire and other wire products has been re-established. Germany also supplies a large proportion of the iron and steel requirements of the Dominion. In this field she has two-fifths of the trade in rails, one-quarter of the market for plates and supplies one-half of the importation of iron and steel pipes. A markedly reduced demand for her general machinery and electrical goods is, however, manifest. The chief import obtained from America is mineral oil and its associated products. Last year American machinery and electrical goods amounted to 1,690,000*l.*, but this year's report shows a reduction to 583,000*l.* There are markets such as that of typewriters, where America had practically a monopoly but is now being hit by competition. Britain now holds 20 per cent of the typewriter market and Germany 13 per cent. The American share of the trade in clocks and watches has now mostly gone to Germany and Switzerland.

How Is Steel Wool Made?—Certain American manufacturers produce steel wool from high-manganese bessemer wire by attaching one end to a power-driven drum. The wire is pulled under several knife blades of the saw-tooth type arranged in tandem in an inclined position similar to a bit in a hand plane. Triangular shaped slivers of steel are shaved from the wire and when about seven-eighths of the wire is converted into steel wool the residue becomes too thin to withstand the pulling strain and is discarded. In later type machines the wool is produced by drawing the wire through circular cutting dies. Foreign-made steel wool is produced by first shaving a thin fiber from soft steel wire in order to present a flat surface to the cutting tool. The wire then is stretched over a frame but beneath the cutting tool in such a way that the wire is shredded into filaments of triangular-shape cross section. This shape renders the wool sharp for abrasive and polishing purposes.—*Iron Trade.*

Ruling a Diffraction Grating for astronomical use is perhaps the most difficult task ever faced by man, says a writer in *Amer. Machinist* (60:5). Some idea of the difficulty may be gained from the following specifications for a 6½-in. plane grating: The ruled surface is to measure 4x5 in. and it shall consist of 75,000 lines, each 4 in. long. Each line must be so nearly straight, that the maximum deviation from absolute straightness shall be less than 1/1,000,000 inch. The spacing must be so accurate that no line must be "out" of its ideal position by more than 1/1,000,000 inch. All the lines must be accurately alike in shape, that is, the width, depth and form of groove must be the same for all. The machine for doing this ticklish piece of work is described at great length in the source mentioned, and is now in operation at the laboratory of Mt. Wilson Observatory in Pasadena, California. The grating to be ruled by means of a diamond is a polished blank of very hard alloy. The wormwheel for operating the lead screw which feeds the work table under the diamond carriage, has 1,200 teeth. The lead screw has a pitch, expressed in fractions as 0.07874 in. The worm makes exactly one turn in feeding for each line to be ruled. Therefore the advance of table and work for each movement is 0.07874÷1200 or 0.0000656 inch.

Gas as an illuminant has largely given way to electricity. Offhand, one might be tempted to make the statement that its manufacture was declining. Yet, says *The Am. Gas Journal*, more than one billion cubic feet of gas a day were used in the United States last year. This represents a 20 per cent increase over the previous, and itself a record year. Its manufacture thus appears to be increasing. This production would be enough to fill the "Shenandoah" 465 times each day. In making a digest of the technical press one is constantly being reminded that the gas industry is a large one. It supports an exceptionally prolific trade press and the contents of that press show that the industry is keen in its competition with electricity as a source of power and light generation. Every opportunity to exploit new openings for gas sales is played up strikingly by the special press of the gas industry. This keenness of competition is reciprocated by the electrical industry, and the public benefits by the practical results of the contest.

The Fight Against the Cotton Boll Weevil has at last been brought considerably nearer ultimate success by the discovery that calcium arsenate is the best existing "dope" for these destructive pests. Now comes a new and better process for making

Even a Barber Pole May Be Motor Driven

PERHAPS you, like the inventor and manufacturer of the animated barber pole, are developing a motor driven novelty, tool or appliance. It may be, too, that a perplexing power problem is handicapping its success. If so, we invite you to utilize the services of our Engineering Department.

This department, for many years closely in contact with the uses of small motors, is accustomed to adapting fractional horsepower motors to "new fangled" applications. And to those manufacturers, who anticipate a change in the power unit they are now using, the advice of these motor experts will be especially valuable. Write them any time.

Dumore motors—dynamically balanced, operate quietly, without vibration. Bearing trouble is thus eliminated—long, carefree service assured. Operating on alternating or direct current, DUMORE high speed motors are exceptionally adaptable. These special features qualify DUMORE motors as the logical choice of manufacturers who require high speed power units for the products they make. Scores of manufacturers of motor driven tools, novelties and appliances, have found in DUMORE motors a satisfactory solution of their power problems. Why not investigate and learn what these sturdy motors can do for you?

WISCONSIN ELECTRIC CO.
4870 Sixteenth St., Racine, Wisconsin

Type-SAX
¼ h. p. motor with special base. Nickel plated. Operates on A. C. or D. C.

Type-A—Stripped
¼ h.p. Cast iron frame, enamel finish, Babbitt bearings, wick oil feed operates on A.C. or D.C.

Type-D
½ h. p. Cast iron frame. Enamel finish. Plain bearings. Grease cups. Operates on A.C. or D.C.

No. 3GM—Stripped
¼ h. p. Aluminum frame. Enamel finish. Norma Bearings. Ventilated. Operates on A. C. or D. C.

Dumore
Fractional H.P. Motors

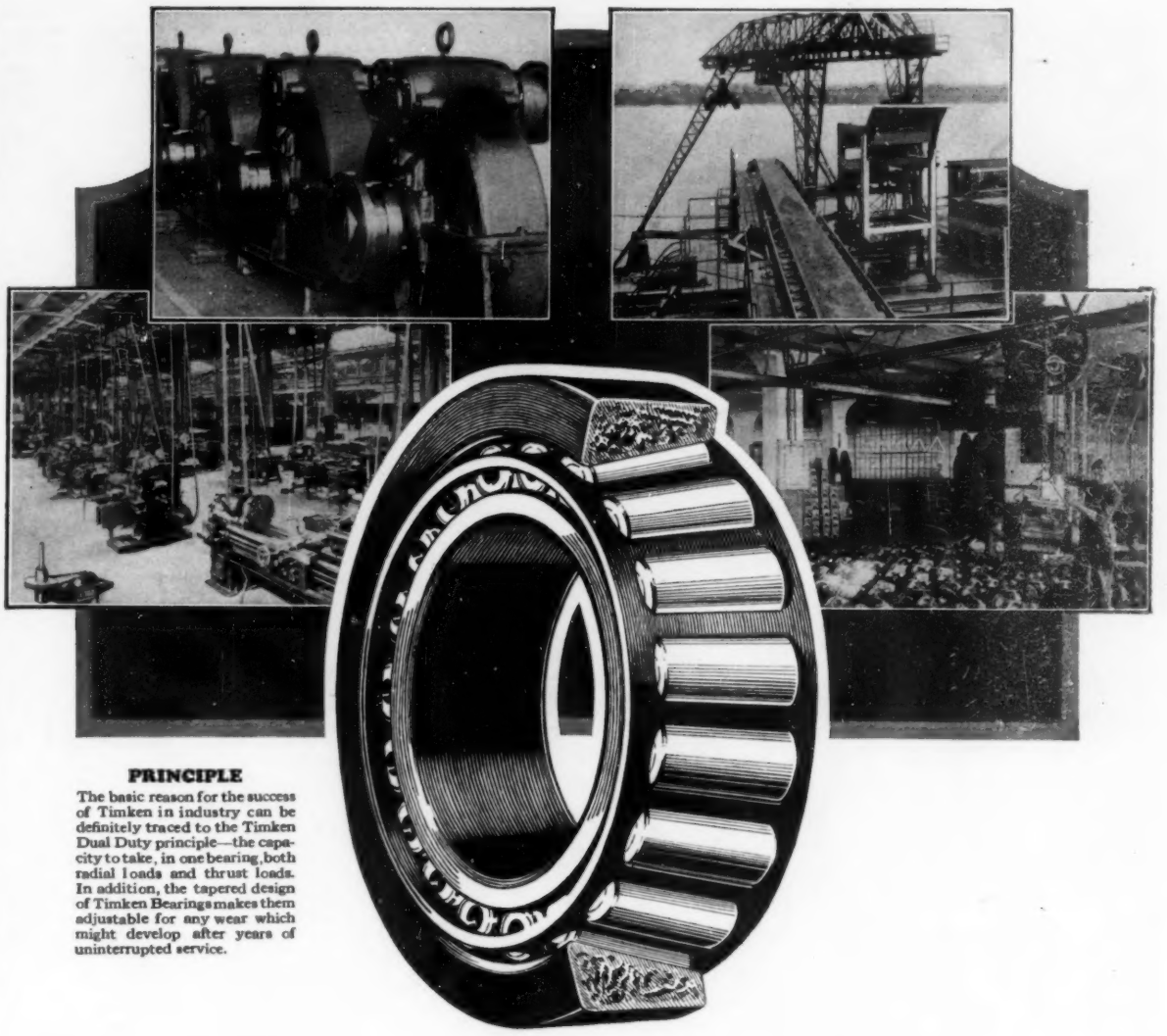
that chemical, accompanied by the hope, expressed by *Mfrs. Record*, (85:5, 1 p.), that it will eventually be lowered in cost to the grower. A process perfected after several years of arduous labor by A. M. Kennedy, of Montgomery, Ala., and Dr. Stewart J. Lloyd, of the University of Alabama, department of chemistry, under the direction and at the expense of the Alabama Power Company, will be used for the production of the poison. The General Electric Company also materially assisted in the experiments giving both Dr. Lloyd and Mr. Kennedy access to their Schenectady Research Laboratories and the assistance of their engineering staff. The old process involves the use of large quantities of nitric acid in the oxidation of white arsenic, expensive both as to cost of production and investment. The Kennedy process is described as an extremely simple one in which electricity takes the place of the nitric acid, thus minimizing the danger, and substantially reducing the initial outlay of capital as well as thereby reducing cost of production. It is claimed that the product so obtained is superior to that made by the old process.

Motion Picture Films—How Long Will They Last?—From time to time we hear of the sealing up of motion picture films to be saved for the benefit of future historians, and the natural question always asked is, "How long will they last?" One answer to this is given in a partly facetious note in *Eng. and Min. Jour.-Press* under the caption of, "Outdoing King Tut." A Chicago film manufacturer is preparing a collection of motion picture films, visualizing mining and other industries, for presentation to the Smithsonian Institution for preservation. Of his technical staff this manufacturer asked the same question, and was informed that they would last anywhere from 10,000 to 50,000 years. The vault in which they are sealed must not, according to stipulation, be unsealed for at least 5,000 years.

Highway Advertising Signs are being done away with in England where some of the principal business interests decided to withdraw their signs from the countryside in sympathy with the movement for the preservation of the natural beauty of the landscape. The example was set by a very large distributor of petroleum products. This company came to the belief, or rather a realization of the fact, that these immense advertising signs were doing them more harm than good, in that motorists who were the logical consumers of their "petrol" were being forced while touring to view the landscape through a sort of low-visibility screen of their advertising, and so were unconsciously building up an antipathy complex against the advertiser. This good example was soon followed by others who no longer were able to set up the defense that "others were doing it."

Uncertain Oil.—As the American people have too recently learned oil seems to belong to the one who gets it. An interesting situation is described in *The Lamp*, a house organ of the Standard Oil Co. of N. J., wherein the ownership of the oil from a certain well was contingent on the fluctuation of level of a lake. The enthusiasm developed in Venezuela a year ago over a well that flowed as much as 100,000 barrels in a single day resulted in several curiosities in drilling. The great well itself, after filling the neighboring swamps and covering the nearby surface of Lake Maracaibo for a radius of several miles with a scum of oil, sanded up and had to be abandoned. The waters of the Lake adjoining the concession on which the big well was located were covered by a concession that extended to the water's edge. Under the terms of the concession any well drilled must be under water, but there was no restriction as to the location of the rig. Consequently, the derrick stands with two of its foundations knee-deep in Lake Maracaibo but the bulk of the rig is on dry land where the drilling rights belong to a different concessionaire. So long as the fresh waters continue to lap against the casing the title to the oil will remain unquestioned, but should there be a few inches' drop in the level of Lake Maracaibo a serious problem may arise.

Getting Heat From the Center of the Earth is impracticable, according to the Bureau of Mines. In descending beneath the surface of the earth the temperature increases continuously with depth at a rate varying from one degree Fahrenheit for 70 feet in depth to one degree in 250 feet, according to the region where it has been measured. Men have ascended over five miles above the surface of the earth. If they could go five miles below the surface in a shaft that deep a region of high temperature would



PRINCIPLE

The basic reason for the success of Timken in industry can be definitely traced to the Timken Dual Duty principle—the capacity to take, in one bearing, both radial loads and thrust loads. In addition, the tapered design of Timken Bearings makes them adjustable for any wear which might develop after years of uninterrupted service.

Timken In Industry

It takes time to solve industrial bearing problems. Each bearing application differs somewhat from any other. Each must have individual engineering attention.

The progress and growth in the use of Timken Bearings in industry has not been startling or spectacular. But it has been a steady progress built on a study of each bearing requirement. In cooperation with industrial engineers, the proper Timken Bearing for each application has been determined.

Today, there are Timken Bearings rendering trouble free service in electric motors, power transmission equipment of all kinds, machine tools, material handling equipment such as conveyors, mine cars, industrial trucks and overhead trolleys, and in scores of other industrial applications.

The results in each case have been the same—longer bearing life, greater freedom from trouble, less lost power, simplified lubrication.

Timken engineering cooperation has helped in many successful bearing installations. Possibly our experience could be of value to you. If so, call upon us.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
Tapered
ROLLER BEARINGS

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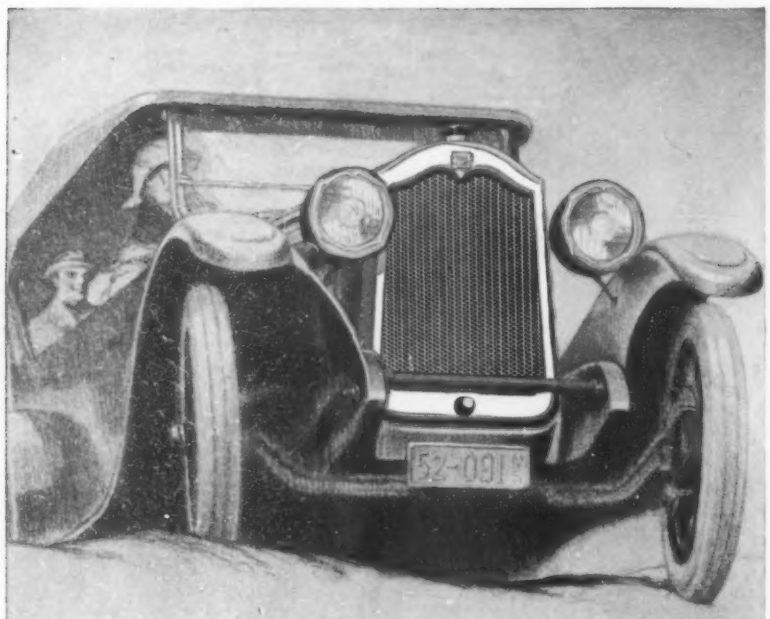

On Steep Hills—
where a motor
must keep cool!

Harrison Radiators can *always* be depended upon to give perfect cooling service no matter how severe or trying the motoring conditions.

Years of manufacturing experience with continual research and experimentation have made possible the development of a remarkably efficient and dependable radiator.

In recognition of this fact the finer motor cars of the past fourteen years have been Harrison-cooled.

HARRISON RADIATOR CORPORATION
LOCKPORT, NEW YORK

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The Mark of Radiator Satisfaction

HARRISON
RADIATORS

be reached, and it would seem as though it ought to be possible to utilize that heat as a source of power, free and perpetual. The principal difficulty is not the cost of penetrating to so great a depth (though a shaft 5 miles deep would cost $5,000,000 or more), but the fact that the amount of heat that can be derived from hot rock is not proportional to its temperature, but is limited by the conductivity of the rock. Comparing the heat with water filtering through porous rock, it is evident that the amount of water that can get through in a given time is not dependent upon the amount of water available, or even on its pressure, but depends chiefly on the porosity of the rock. The heat conductivity of rock is low, and in order to get any considerable quantity of heat through in a unit of time the area of surface exposed must be large. The second important difficulty depends on space; the heat is available five miles below the surface, but it can only be usefully employed on the surface and how to get it there without losing most of it on the way is the problem. One suggestion is to pass water down, and circulate it through large galleries at the bottom, thus giving it time to take up the heat, even at the slow rate of transfer that exists. This would give us water at a high temperature and pressure, but at the bottom of the shaft, where it is no more useful than ice is in the polar regions. In rising to the top of the shaft, the hot water would cool down at about the same rate as it heated up in descending. Even with extremely efficient (and expensive) heat insulation on the up-going pipe, so much of the heat would be lost that what remained would not pay for the cost of getting it, at least until coal and other sources of power are much more expensive than they are now.

Industrial Progress

New Process for Obtaining Low-Ash Coking Coal.—Almost all coking coal districts contain large quantities of coking coal of higher grade than any heretofore available for making low-ash metallurgic coke. This low-ash coal exists in coal beds of both good and poor quality and is scattered through the coal in masses from ¼ inch up to 1, 2, 3 or 4 inches in diameter. There is no visible distinction between these masses of pure coal and impure coal. As the specific gravity of each piece of coal depends upon the quantity of ash present in that piece, the differences in specific gravity can be used for separating the low-ash and high-ash coal. The specific gravity increases about .01 for each per cent of ash. If separation be made by a "float and sink" method by introducing the coal into a liquid of the desired specific gravity, as for example 1.36, all the coal having a specific gravity less than 1.36 will float and all the coal having a greater specific gravity will sink. An exact separation thus can be made, dividing the coal into two grades. Solutions of high gravity and liquids can be used for making such separations experimentally, but not commercially. However, the sand flotation process can be used by which a liquid of any desired specific gravity can be produced and utilized to make such separations. The sand flotation process utilizes an agitated mixture of sand, or other suitable material, and water as a "fluid mass" of relatively high specific gravity. The sand is kept in suspension in the water by controllable means for providing agitation and readily can be maintained at any desired specific gravity. The specific gravity is under close control and can be varied accurately at will. This process was introduced in the anthracite districts of Pennsylvania two years ago. There now are six plants in operation and another soon will be completed.—*Iron Trade*, 74:3, 1p.

Disposal of Creamery Wastes by the activated-sludge method has proved satisfactory in laboratory experiments at Iowa State College, Ames, Iowa, made by Dr. Max Levine. A creamery waste differs markedly from ordinary sewage in many respects but particularly in that it contains the carbohydrate lactrose which rapidly undergoes acid fermentation, thereby rendering the waste extremely refractory to septic tank treatment. Ordinary digestion of creamery wastes develops so much acid that the regular regime of a septic or Imhoff tank is entirely upset if the creamery volume is at all a considerable portion of the sewage. The right kind of digesting bacteria cannot grow on acid media; they thrive in a slightly alkaline medium. Observations were made on the effect of aeration of various concentrations of skim milk and of buttermilk with respect to changes in oxygen requirement, nitrogenous matter, turbidity, relative stability and removal of solid constituents. An activated sludge may be developed in about two weeks from 2 per cent skim milk. Aeration of 2 per cent skim milk for 16 to 25 hours in bottles or in barrels (with 20 per cent activated sludge and 50 to 60 cu. ft. of air per gallon) effected marked reductions in turbidity, acidity, total solids, organic nitrogen and, particularly, oxygen consumed and demand. Reductions of 95 to 98 per cent in the oxygen requirements were generally obtained.—*Eng. News-Record*, 92:4, 1 p.

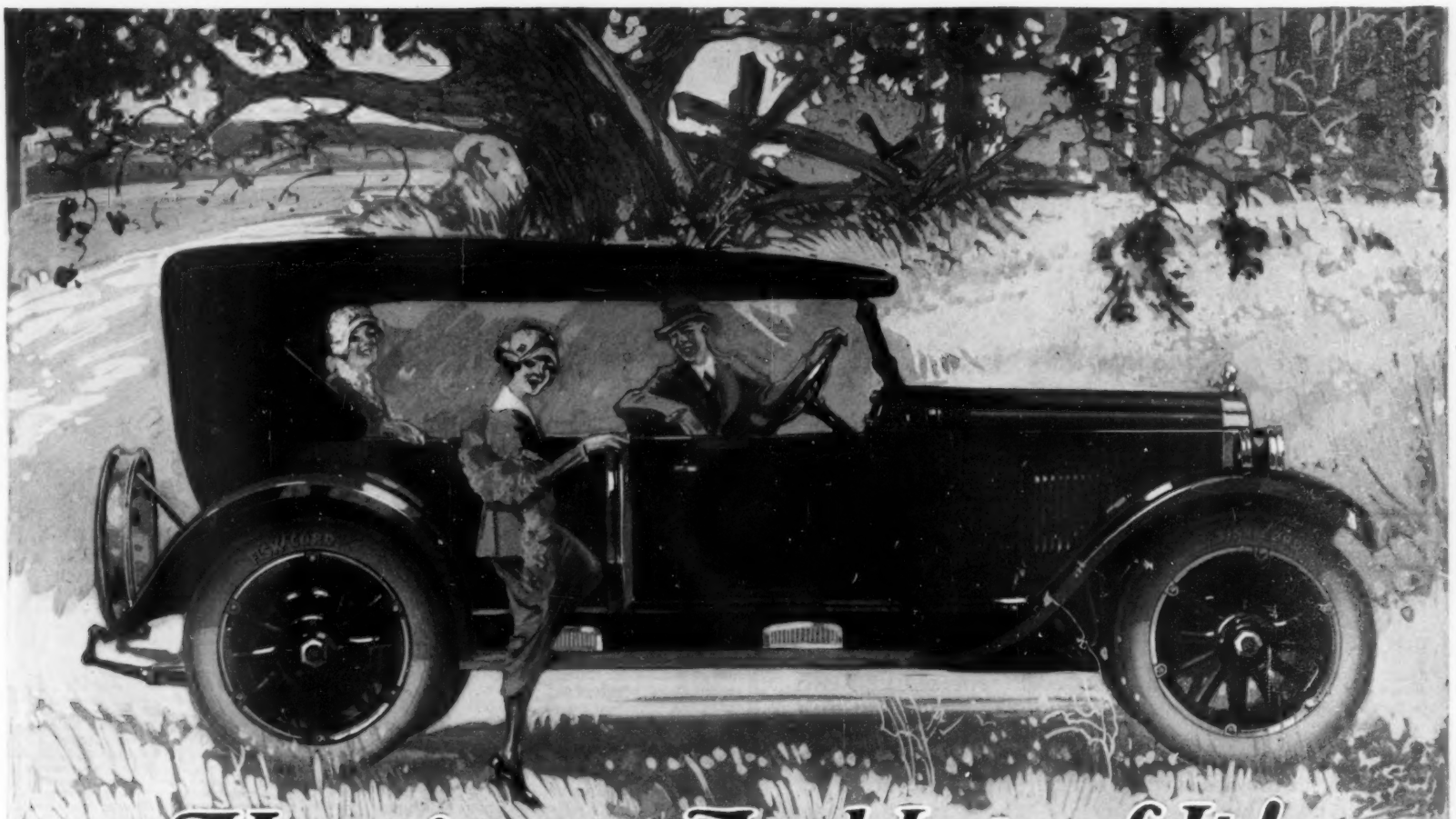
Rubber Flooring is, according to a writer in *India Rubber World* (69:5, 2 pp., ill.), destined to become as general as rubber heels. The development of less than three years in the production of multiple colored, reinforced rubber flooring, in which the cotton fiber has been reduced to the merest tissue and vulcanized under high pressure, has convinced many persons as to its desirability in many different classes of buildings. Its supplementary use for wainscoting, bases, surbases, stair treads, and other purposes is also being developed satisfactorily. Reinforced rubber flooring combines the ideal features in all types of flooring with none of the disadvantages. It has no drawback except that the first cost is somewhat higher than other types of floor which are necessarily temporary in character. Reinforced rubber properly applied will last as long as the house. This country will be using reinforced rubber flooring at an annual rate far in excess of 100,000,000 square feet within ten years.

Making Metal Patterns by Electro-Deposition.—This method is perhaps the one big advance step made in the producing of metal patterns in the last twenty-five years. Casts of wax, plaster of paris, or any fusible alloy are taken of the pattern to be reproduced. These casts are made of conductive material on the impression surfaces. In the case of wax or plaster of paris, graphite is used to make the conductive surface. Contact wires are inserted in the casts to make a connection in the plating tank and conductive surface of the cast. Suitable insulation is given these casts to prevent the metal from spreading on the non-conductive surfaces. These casts are then placed in the desired plating solutions, and are allowed to run until the desired thickness is obtained. The casts are taken from the bath and the metal deposits removed. They are backed up by some suitable alloy, such as white metal, to give strength, if necessary. The partings are then checked very closely and machined or ground off, if required, and from this point the procedure is identical with the old method. The method is so sensitive that it will reproduce the finest hair line. It is possible to ascertain whether the patterns are made from a mahogany, pine, or metal original, as in mahogany, the grain of the wood can be clearly seen on the finished article. Center lines on wood or metal patterns to be reproduced show up very plainly. This method is fast being adopted by many of the large automobile manufacturers in the United States, due to the high degree of accuracy obtained in producing duplicate metal patterns, as well as the comparatively low cost.—*Metal Ind.*, 24:3, 1 p., ill.

A New Burner for Refineries has been placed on the market, in which there are two separate pipes. The steam enters through the upper pipe and the oil through the lower. In the mixing chamber the oil rises to about the base of the cup. As a result of the whirling motion given to the steam, which expands over the curved surfaces in a manner similar to the expansion which occurs in a steam turbine, the oil and steam become intimately mixed and fill the entire chamber. The mixing chamber serves as a reservoir and tends to prevent the sudden changes in the size of the flame which are apt to result from fluctuations in oil or steam pressure. This action is comparable to the action of an air chamber on a pump in steadying the discharge pressure. The oil may be fed by pressure or gravity. As low as 20 pounds per square inch steam pressure will effect complete atomization of the oil.

The New High-Pressure Steam Boilers have introduced a number of new considerations. Evidently, thinks the *Iron Age*, any uncertainty regarding the ability of materials used for valves, boilers, piping, turbines, etc., to withstand the stress of steam pressures up to 1200 lbs. per square inch, has disappeared. The problem now is to determine operating pressures that will assure the minimum cost of power for steam temperatures not exceeding 750 deg. Fahr., this point being described as the absolute limit with present materials. The problem was discussed in

(*Continued on page 274*)



Happiness-And Lots of It!

YOU ARE bound to be happy with a Willys-Knight. Happy in the very beauty of it—in the silky action of it—in the price of it—happy, most of all, in the wonderful way it keeps going on and on and on without need of tinkering and fussing with the engine.

The Willys-Knight sleeve-valve engine *actually improves with use.* No hammering cams. No clicking springs. No valve-grinding. No bother with carbon. No sticking valves. None of the woes of ordinary poppet-valve engines.

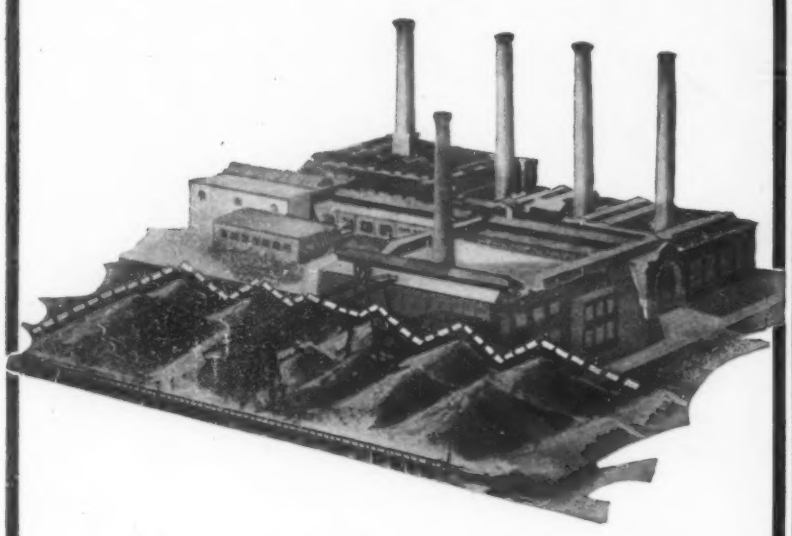
This is the same type of engine used in the costliest and most famous cars of Europe. Willys-Knight owners report 50,000 miles and more without so much as touching a tool to the engine.

If you want real happiness in a motor car—and bigger mileage—own a Willys-Knight. *The day of the Knight is here!*

WILLYS-OVERLAND, Inc., TOLEDO, OHIO
Willys-Overland Sales Co. Ltd., Toronto, Can.

Willys-Knight Models: 2-pass. Roadster $1175; 5-pass. Touring $1175; 7-pass. Touring $1325; 5-pass. Coupe-Sedan (Standard $1450, De Luxe $1550); 5-pass. Sedan $1795 (De Luxe $1895); 7-pass. Sedan $1995; all prices f. o. b. Toledo. We reserve the right to change prices and specifications without notice.

WILLYS-KNIGHT



SAVED 10 PER CENT OF THIS 105,000 TON PILE

This mountain of coal representing two months' reserve fuel supply kept on hand by a large New England light and power company would have to be 10,500 tons larger were it not for the savings effected by Sturtevant Fuel Economizers.

A Sturtevant Fuel Economizer is a series of metal pipes thru which the feed water circulates before entering the boilers; these pipes are placed in the path of the flue gases as they pass up the stack. When the gases from the fires are ready to pass up the stack, their temperature is around 550°. A Fuel Economizer placed in their path absorbs about 250° of this heat—the heat for which you pay cold cash.

One of our power plant engineers is located near you. He will be only too glad to look over your plant and give you an approximate estimate and the cost of installation and what you should save by the installation of a Sturtevant Fuel Economizer, or where other Sturtevant equipment will bring economy in your plant.

Bring Your Problem to Sturtevant

B. F. STURTEVANT COMPANY

Plants located at

Hyde Park, Mass. Framingham, Mass. Sturtevant, Wisc.
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Sturtevant
PUTS AIR TO WORK

Scientific American Digest

(*Continued from page 272*)

two papers, one by W. J. Wohlenberg, assistant professor of mechanical engineering at Yale University, and the other jointly by C. F. Hirshfeld, chief of the research department of the Detroit Edison Co., and F. O. Ellenwood, professor of heat power engineering at Cornell University. Mr. Wohlenberg finds that the thermal efficiency of a generating station falls off beyond a pressure of 1000 lbs. per square inch, while Hirshfeld and Ellenwood conclude that this efficiency shows continuous improvement beyond 1200 lbs. per square inch, which was the highest pressure for which they made their calculations. Taking into account investment charges, maintenance and fuel charges, the authors show that the maximum commercial efficiency is obtained at a pressure of 900 lbs. per square inch, using coal costing $5 a ton and at a pressure of 1000 lbs. per square inch with coal at $8 a ton. Apparently little is gained beyond pressures of 500 lbs. per square inch, when coal cost $5 a ton, or 700 lbs. per square inch when the cost of coal is $8 a ton.

Economic Waste is successfully being warred against by the Department of Commerce. There have been altogether too many sizes, shapes and grades of a thousand-and-one different manufactured products. Common sense indicates that in the majority of these cases the buyer would be as well satisfied if he had a score of sizes of, say, bedsprings or of paving bricks to choose from instead of that many sizes made by each manufacturer, with each manufacturer's sizes all different in some degree from those of other manufacturers of the same product. For this bad situation no one is to be blamed; but it was recognized that if they could be brought to a common agreement by some disinterested outside agency an immense amount of economic waste would be eliminated. This work of the Department of Commerce has been going on for quite a time and has permeated scores of special industries. Most manufacturers have been only too glad to weed out odd sizes, etc., of their product, since the general reform assures them that their competitors will not profit unduly by the weeding out. Of course this work results in a sort of standardization, and while one man may regret, for instance, that the peculiar variety of machine screw that he has been using has been dropped, the majority will be pleased because they will find that there is a better future chance of matching the size, thread, etc. they want. About 80 per cent of most products have been dropped. The work has gone on quietly and without great notice outside of the technical press, but it has received considerable notice in the latter. If the actual saving of material and human effort brought about by this reform could be made in some other manner that would be more dramatic it would be emblazoned on the front page of every newspaper in the country.

A New Non-Corrosive Pipe-Lining Process.—Some attention is being given in Britain to a system whereby cast-iron and steel water pipes can be lined with concrete to prevent that corrosion which has always proved such a trouble in the past. These pipes are being manufactured by the Hume centrifugal process, whereby the pipes are formed in revolving moulds. Experiments made proved that concrete would adhere permanently to a polished and oiled surface. The process is carried out as follows: portland cement and crushed granite are the materials used. When ready, it is conveyed to troughs which lie alongside each of the centrifugal machines used for the actual manufacture of the concrete-lined pipes. Rings are placed at each end inside the pipe to retain the concrete in place, otherwise, as soon as the pipes started to revolve, some of it would be ejected at each end. A slow rotary movement is then given to the pipe and is continued for ten minutes or so, and, while this is going on, sand and cement are introduced at each end. The concrete mixture adheres to the internal surface of the pipe by centrifugal force and as soon as sufficient material has been introduced, a hand tool being used to get the mixture along the pipe, the speed of rotation is considerably increased resulting in the coarser parts of the concrete being made to close up to the surface of the pipe, whilst it also results in the liquid in the concrete being slowly evacuated from its body. The liquid really forms a thin film on the surface of the concrete but as soon as the pipe stops spinning this film falls to the bottom and can be brushed out when the internal

(*Continued on page 276*)

KEYSTONE
Rust-Resisting Copper Steel

KEYSTONE COPPER STEEL

Black and Galvanized
SHEETS

Formed Roofing Products
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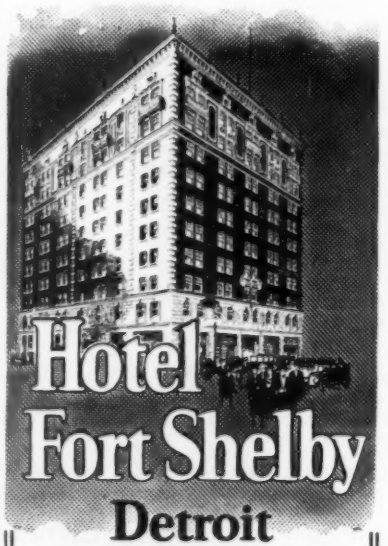
Secure maximum *rust-resistance* from all sheet metal products by insisting upon copper-steel. Its excellence is a well established metallurgical fact. The proof is conclusive.

KEYSTONE COPPER STEEL is an alloy made by the addition of a certain percentage of Copper to well made Steel, thereby increasing its lasting and rust-resisting qualities under actual service condition. Unexcelled for culverts, tanks, flumes, roofing, siding, gutters, spouting, and all exposed sheet metal work. Send for booklet giving results of positive time and service tests.

We manufacture Sheet and Tin Mill products for all purposes—American Bessemer Steel Sheets, American Open Hearth Steel Sheets, Keystone Copper Steel Sheets, Black Sheets, Special Sheets for stamping, Sheets for Electrical apparatus, Automobile Sheets, Deep Drawing Sheets; Apollo and Apollo-Keystone Galvanized Sheets, Corrugated Sheets, Formed Roofing and Siding Products, Culvert and Flume Stock; Long Terne Sheets, Roofing Terne Plates, Bright Tin Plate, Black Plate, Etc.

AMERICAN SHEET AND TIN PLATE COMPANY, Pittsburgh, Pa.



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A leader among Detroit's finest hotels, Fort Shelby is the choice of travelers who know the unusual comforts and conveniences enjoyed by our guests. Rates, starting at $2.50 a day, are notable for considerate moderation. Servidor Service.

Convenient to rail and water terminals. M. C. Depot cars stop close by.

The hotel that made Detroit famous for hospitality

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The World's Lowest Priced Complete One-Ton Truck

The constantly increasing use by nationally known concerns of Ford Worm Drive Trucks mounting the new all-steel body and cab is a convincing endorsement of this, the world's lowest priced complete One-Ton Truck. Price $490.

Meat packers, wholesale and retail grocers, bottlers, coal and ice dealers, creameries, or any business requiring reliable transportation find in this sturdy well built truck the most economical means of delivery.

The body and cab are the latest Ford product, designed and built for general haulage work. The body has steel flare boards, and is provided with sockets which permit the use of stakes and high side boards or the mounting of a canopy top. Screen sides and end doors are easily installed, making the body readily adaptable for a wide range of business requirements. Loading space is four feet by seven feet two inches.

The efficiency of the famous Ford Worm Drive One-Ton Truck is being constantly demonstrated by thousands of concerns in widely varying lines of business. Ample power, ease of control, mechanical simplicity and every-day dependability, together with the low first cost and exceptionally low operating and maintenance costs are reasons why the Ford One-Ton Truck is the most popular truck in the world.

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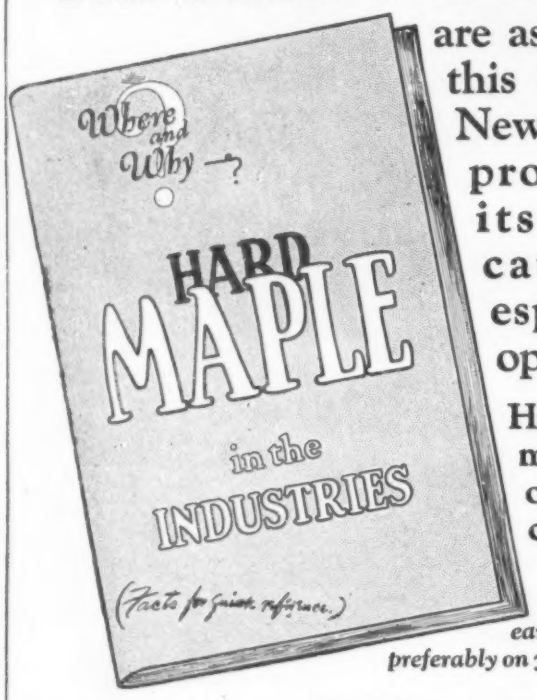

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Scientific American Digest

(*Continued from page 274*)

rings at the ends of the pipe are removed. When the concrete is set the pipes are put away for three or four weeks, at the end of which time they are reckoned to be ready for use. Most of these pipes are made with a lining of one-half inch concrete but if required, this can be increased to one inch or more.—*Cement and Eng. News*, 36:1, p. 47.

Coal Processing had a banner year in 1923, according to an editorial in *Chem. and Metall. Eng.*, (30:3). Especially is this true of the manufacture of water-gas, in which there has been a widespread recognition and general adoption of the "backrun gas" process. This system of making gas permits the use of bituminous coal in the water-gas generator and requires less oil for carburetion. Along with these benefits, the heat losses are decreased as compared with those of the standard water-gas set, and the deposit of carbon on the checkerwork of superheater and carbureter is prevented. In the field of byproduct coking the outstanding feature of the year is one that holds great promise for the industry. The Becker design of coke oven (Koppers patents) proved so successful as practically to supersede all other types in the contracts let for new construction. This oven was first brought to the attention of the field in 1922, when an experimental plant of five ovens was erected at Chicago. This oven has proved to be a great advance in the art and has lessened the time required for coking sufficiently to decrease greatly the capital charges against coke and has at the same time extended the range of coals available for coking, as it will coke coals heretofore uncokable.

Liquid Chlorine is Fast Replacing Bleaching Powder, according to a writer in *Chem. and Metall. Eng.*, (30:3). No branch of the heavy chemical industry has undergone such radical changes in the past two or three years as the electrolytic manufacture of alkali. The year 1923 saw the largest step yet taken in the replacement of bleaching powder, which is known commercially as "bleach," by liquid chlorine. It is safe to say that in 85 to 90 per cent of all places where bleaching powder was or is used it can be replaced by liquid chlorine and show a material saving. In 1918 the liquid chlorine capacity of this country was about 7900 tons per year (equivalent to approximately 23,700 tons of bleach), the large percentage of chlorine then going into bleaching powder. Jan. 1, 1924, the liquid chlorine capacity of this country was approximately 33,000 tons per year (equivalent to 99,000 tons of bleach), which shows the increasing consumption of liquid chlorine in replacing bleaching powder.

Oxygen by the Liquefaction Process.—Very few of the large industrial users of oxygen in this country have owned plants for producing the oxygen they require, because the economic use of the electrolytic process involved the disposal of the hydrogen simultaneously generated and until very recently there was no satisfactory liquefaction unit available. Within the past two years, however, there has been placed in successful operation in more than thirty plants a liquefaction system that should be of great interest to all large users. In outline, the process, is exceedingly simple. Air is freed from carbon dioxide and suspended matter in caustic potash scrubbing towers, brought to high pressure in a multi-stage compressor, dried by solid caustic potash while still under pressure, liquefied by sudden expansion and oxygen separated by fractional distillation of the liquid air.—*Chem. and Metall. Eng.*, 30:5, 4 pp., ill.

Simplification of Manufactured Products in general is being brought about through efforts of the Department of Commerce. This is simply an effort to reduce economic waste. An excellent patient of this sort on which to operate is cited by *Automotive Industries*. One prominent make of six-cylinder passenger car uses 7 sizes of carriage bolts, 16 sizes of cotter pins, 5 sizes of Whitney keys, 19 sizes of rivets, 98 sizes and types of machine screws and 57 sizes of wood screws in body work.

Floating Roof Tanks.—The petroleum industry has recently shown such great interest in the prevention of evaporation losses from crude oil and gasoline that almost daily there is being developed and placed on the market equipment designed especially to reduce these losses, states Ludwig Schmidt, assistant petroleum engineer, Department of the Interior, in Serial 2547, recently issued by the Bureau of Mines. Among the recent developments is a new type of tank roof known as the "floating roof," which practically eliminates the vapor space over the surface of the oil, thus removing one of the chief causes of evaporation. There are at present at least two types of floating roofs, which, while similar in fundamental principle, differ mainly in the method of making contact with the inside shell of the tank. One type of floating roof is known as a floating tank deck, and has on its circumference flexible metal baskets containing gravel that rest against the inside shell of the tank. In the other type of floating roof contact with the tank shell is made by the use of movable buffers or shoes. These are attached to the outer ring of the roof and are pressed against the tank shell by means of springs. The primary function of the floating roof is to reduce evaporation losses by eliminating the vapor space above the oil, thus preventing breathing losses and losses due to circulation of air over the liquid. By elimination of the vapor space the fire hazard is also reduced in that there is no large confined space filled with explosive vapor, nor is there any large body of liquid exposed to the air. With this type of construction the exposed liquid is in a very narrow slot of sufficient depth to prevent free circulation of the air which is necessary to support combustion. Floating roof tanks have been illustrated in recent issues of the SCIENTIFIC AMERICAN.

Cerium is usually regarded as belonging to the general group of rare earths, as it invariably occurs in nature associated with the other members of the group, and is very similar to the other rare-earth elements in many of its chemical properties, states J. P. Bonardi, in Bulletin 212, recently issued by the Department of Interior, through the Bureau of Mines. Cerium is now obtained mostly from monazite and from monazite sands. The mineral monazite occurs in Norway, in Ural Mountains, in North and South Carolina, and in Canada. The disintegration product from the mineral called monazite sand is fine gravel or sand, and occurs in river banks and on the seashore, principally in Brazil, North and South Carolina, Australia, the Ural Mountains, and in the State of Travancore, southern India. The monazite content varies from a trace up to 4 per cent, so that some method of concentration must be employed, such as washing by placer methods, wet table concentration, or magnetic separation. The most important use for cerium is in the manufacture of gas mantles for incandescent lighting. Cerium is also utilized in combination with other cerium earths—in pyrophoric alloys, and for "tracer" shells and bullets. Alloys of mixed cerium—earth metals are used as reducing agents to produce metals from metallic oxides. A mixture of about 35 per cent iron and 65 per cent cerium is used for automatic lighters. Various combinations of various metals with cerium have been patented for use in pyrophoric alloys. It is claimed that the addition of 0.2 per cent of cerium metal to aluminum definitely improves its physical properties.

Duriron is generally known as an acid-resisting material, but its wide range of applications to various industries is not universally appreciated. Duriron valves, cocks, piping, pumps, exhaust fans and containers are used for the handling and storage of muriatic, nitric, sulphuric, phosphoric and other acids used in the cleaning or coloring of brass. The alloy is entirely resistant to the action of sulphuric, nitric and phosphoric acids of any strength or temperature, and so slightly affected by muriatic that it is entirely practical for handling and satisfactory for commercial uses. Duriron is produced in many forms and while it is too hard to machine by ordinary methods, grinding machinery has been devised so the material may be fabricated into special equipment or parts for standard machinery subject to corrosion. A great advantage in the use of Duriron is its well nigh universal acid resistance. A wide use has been found for Duriron anodes, both for use in metal refining and recently as an insoluble anode for increasing current density in plating operations, and for various other metallurgical purposes. It is also produced in great volume in the form of standard drain pipe and fittings which are particularly adapted to handling corrosive wastes. This drain pipe is installed exactly the same and as easily as cast iron. Duriron tank outlets and connections, circulating steam jets and similar equipment for pickling and plating are widely used. In short, Duriron is paid up insurance against loss and depreciation wherever acids are used commercially.—*Brass World*, 20:1, note.

Lead exempts you from a weather tax

HOW much is your weather tax? Thousands of owners in the United States pay such a tax for the share of rain, snow, and sunshine that fall on their properties.

One billion dollars' worth of property crumbles beyond repair in this country each year. And this vast total includes the many millions paid by property owners as weather tax—money that lead would help to save.

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Lead is the ugly duckling among metals. It isn't so handsome as gold. It isn't so strong as iron. Yet lead performs many functions—for which the other metals are not suitable. In the form of white-lead in paint it is man's mightiest protector of wooden and non-metallic surfaces.

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Approximately 350,000,000 pounds of white-lead are used every year in this country. This makes enough paint to cover with one coat about 3,000,000 houses of average size. On the outside and the inside of homes, churches, schools, barns, theatres and stores, white-lead foils the attempts of sun, air, and moisture to collect a weather tax.

Where man pays the tax

But the weather still collects some of its toll. Frequently you see a home that once was fresh and new, but now is rotting away. The porch floor is not safe. Window sashes are rotting. The sides of the house are weatherbeaten and worn. On inside walls are great damp spots where moisture has penetrated.

White-lead would have prolonged the life of the house. It would have been an impassable barrier to air and moisture. As long as its film was unbroken it would have kept the covered surface safe.

And after all, the first cost of white-lead paint is small when you consider how such paint protects your home, your property, and the money you invested in it.

White-lead a standard covering

From the days of our forefathers, white-lead has been the standard for preventing decay and deterioration and for providing the desired decoration. Wise property owners everywhere are obeying the rule, "Save the surface and you save all," and are covering the surface with white-lead paint. Thus they avoid paying weather and repair taxes.

Rain and storm have attacked this pillar, which was unprotected by paint. The owner is estimating the size of his weather tax

For exterior painting they find that white-lead and pure linseed oil make a paint that sticks tight to the surface, is impervious to moisture, and lasts long. And they know that fresh-looking, well-kept property is an asset to the community, a sign of cleanliness and respectability within.

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Besides its use in paint, lead has many other interesting uses. In fact, the story of lead is a fascinating one, and if you want to know more about this wonder metal, we can recommend a number of interesting books. The latest and probably the most complete story of lead and its many uses is "Lead, the Precious Metal," published by the Century Company, New York. If you are unable to get it at your bookstore, write us or the publishers.

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Our Abrams Investigation—VII.

(*Continued from page 240*)

he experiences the reactions. If he is working with a known blood specimen—one which is accompanied by a case history or one which has been taken from the patient in person—the reactions are usually strong and readily detected by the diagnostician. Hence his findings are definite and quickly arrived at, in marked contrast to the weak and uncertain reactions when a "blind" specimen is being tested, especially under rigid test conditions.

We have in this procedure all the elements of the familiar ouija board experiment, in which two persons, quite unconsciously, push a tiny pointer over the letters on a large board, spelling queer messages which have their origin in the subconscious minds of one or both sitters. The E. R. A. practitioner has been taught that at the bottom of all ailments there is a basic toxemia, originally called congenital syphilis, but since changed to the more euphonious and less harsh name of "diminished resistance" or "D. R." for short. Then, too, he has been taught that tuberculosis, carcinoma, sarcoma and other troubles are far from rare. If not developed to a point where they may be detected by ordinary clinical diagnosis, he is told, they are usually present nevertheless in an incipient stage. Furthermore, so runs the story, the electronic diagnosis is so much more sensitive and accurate than the clinical, that these things are detected from the electronic reactions long before their presence would be made known by the more usual technique. The mere fact that a thorough clinical examination, including X-ray exploration, the Wasserman test and other procedures in which modern medicine places much faith, fails in many instances to check up with the E. R. A. findings, means nothing whatever save discredit to the orthodox doctor. E. R. A., its protagonists insist, *must* be correct; clinical findings that diverge must be wrong. Which is mildly amusing in view of the fact that, in his original identification of his rates, Abrams relied upon clinical diagnosis wholly; obviously no other course was open.

The writer can hear a storm of protest from E. R. A. ranks against these statements. Even though the E. R. A. gentry have done absolutely nothing for our Committee in the way of submitting their technique to simple tests, though repeatedly urged to do so by their leaders, they are always ready to take exception to whatever opinions we may form in the absence of their cooperation. They demand that we accept E. R. A. claims without proof. Still, even though they have preferred, so far, not to undergo our tests, we have been going ahead with excellent results.

Our observation and tests with regard to the subjective nature of the reactions have been interesting and, so far, convincing. Nor are we alone in the viewpoint to which they have led us. Not so long ago, a prominent electrical manufacturer was asked to make a sample resistance box, according to certain specifications, for an Abrams practitioner. The order was filled, and in view of all the circumstances, a very competent engineer of the company was designated to see the box installed and tried out. He took the liberty of removing essential parts of the internal mechanism of the box, without informing the "doctor." The box was nevertheless placed in the electronic circuit, and the reactions obtained through it with all accustomed clarity. The engineer went further, and disconnected some of the external connections; but the reactions were in no whit embarrassed. So much cannot be said for the Abrams practitioner when he learned what had been done, however.

If this happened to you or to me, we should seriously question the technique under which such a damning thing could happen. Well, the E. R. A. man in the case may have questioned; but if he did, he didn't question out loud. His sole visible response was to try to get the engineer to promise never to tell anybody about it. And he is still diagnosing with the electronic apparatus, and without apology. Waiving this rather obvious and important matter of the doctor's good faith, however, when the vibratory rates come through an empty box and open connections, one must wonder whether the whole technique means anything, after all.

Then we have the case of an engineer who has given a great deal of attention to the physical side of the electronic technique. He has worked out elaborate diagnostic equipment which, on its very face, must command deep admiration. We who have worked with delicate radio equipment, even to sensitive and highly accurate wave-meters, know

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precision apparatus when it is placed before us. Then, to cap the climax, we were shown a number of curves of various diseases, carefully plotted on quadrilled paper with the same precision as a wave-length curve for a variable condenser or other piece of radio equipment. Could it be that we were getting down to this marvellous simplicity in medicine, when every disease would be measured and recorded, its wave length established in centimeters? Already we had visions of the future doctor—a studious young man with a collection of good looking apparatus and a heavy loose-leaf note-book as his main stock in trade, manipulating the apparatus and referring to his wave length charts, and finally giving us a detailed diagnosis of even our most minute irregularities, such as the most skilled diagnostician of the old school could not do in a thousand years.

"How were these remarkable curves obtained? we asked. To which was the reply: "Well, you see, for the time being we make use of a human reagent—the Abrams technique, you know—but only for the time being. We are to have a substitute for the human reagent." We asked if we might see these curves in the making. "Certainly," came the cheerful reply. "Arrangements have been made to run through a typical test this evening. One of the most skilled Abrams diagnosticians will elicit the reactions."

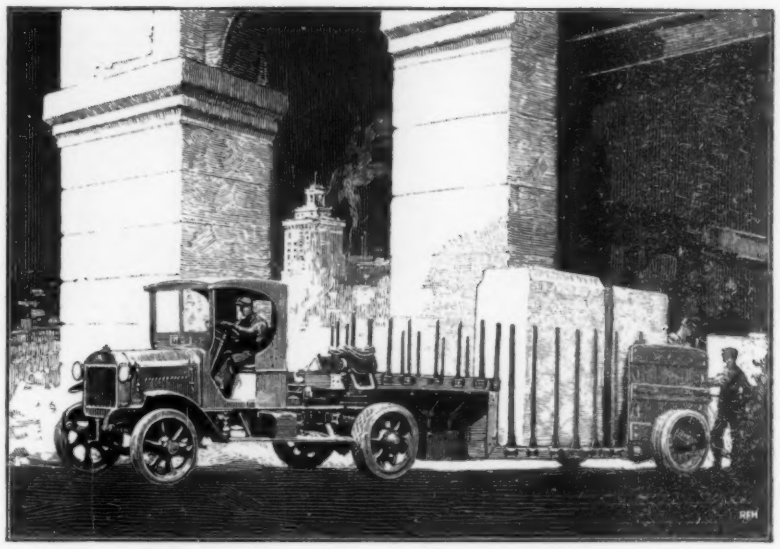
Several hours later we were ushered into a small room in an office building occupied mainly by doctors, and introduced under an assumed name to an elderly practitioner. We shall not mention the city nor give any details which might disclose the participants in this particular test, for nothing is served by giving names when we are primarily interested in the technique itself and not in the individuals, *per se*. The elaborate equipment was rapidly assembled for the test. A young lady was to serve as the reagent. To give the procedure the earmarks of a scientific demonstration, a temporary screen was placed between the doctor and the engineer manipulating the instruments.

Soon the test got under way. A pure germ culture of typhoid was to be measured for the purpose of plotting the typhoid curve, though E. R. A. has already admitted the impossibility of identifying pure germ cultures! The engineer would adjust the wave-length device, then determine the potential of the reactions for that wave length, before going on to the next wave-length setting, and so on. In this manner, so the theory goes, a number of points would be obtained based on the potential for each wave-length setting, thus giving the gradual swing of the curve up to the peak, and down again on the other side.

The procedure was not very impressive. Several hours of precious time were used up. Finally, the writer asked if he might manipulate the apparatus. The request was immediately granted. Then, sitting behind the screen, the writer's first move was to disconnect one of the wires. This, evidently, made no difference. The doctor pronounced a good strong reaction, just the same. The engineer rushed into the breach with an explanation. It makes no difference, he informed us, whether the wire connections are disturbed or not; the electronic energy jumps across wide gaps with the greatest ease. One's first impulse would be to ask why have the elaborate apparatus, if this is the case; but in point of fact there is an even more serious aspect than this.

In this particular set-up, the potential or quantity of the disease is measured, not in "ohms," but in centimeters. An adjustable gap is provided in the wiring, and, starting from actual contact, this is widened until the reactions cease to be felt by the operator who is at work on the reagent. Width of the gap which stops the passage of the energy is then taken as the measure of the energy's intensity; and this gap is in no case more than about two feet—usually much less. It is very surprising, after this, to be told that the apparatus may be disconnected and an additional gap of four or five feet introduced without any effect whatever upon the readings. This, however, is quite consistent with the extraordinary facility of the electronic practitioners in devising explanations that are, when analyzed, more absurd than the irregularities which they seek to explain.

Our next move, then, was something less apt to be circumvented by the eccentricities of the electronic forces. Without the doctor's knowledge, we picked up a test tube containing a brown gelatinous matter quite similar in appearance to the contents of the tube resting in the diagnostic slide. We asked the doctor if the reactions were still present. The answer was in the affirmative. And why shouldn't they be? The specimen was



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still in place. Then we handed the extra specimen to the engineer, who was sitting in plain view of the diagnostician, with the remark that we were interested in timing the "lag" in the reactions. Nothing was said to the doctor, but he could see the passing of the specimen back and forth. After ten seconds of stroking, the diagnostician announced that the reactions were "off." This was rather interesting, since the original typhoid specimen was all the while in the diagnostic slide. We asked the engineer for the extra specimen, and acted as though it were being placed on the apparatus. About eight seconds later, we were told that the reactions were back again. Not satisfied with this much, we handed the extra specimen back to the engineer. Twelve seconds later we were told that the reactions were gone. Upon taking back the specimen, the reactions returned in some ten seconds. All the while the original typhoid specimen had been left in place.

Here we have a splendid case of suggestion, controlling the involuntary muscular action of the stroking procedure. That the diagnostician in question was sincere, we have not the slightest doubt. That his subconscious mind directed his hand so that the "reactions" were gone when the specimen was apparently removed from the slide, and again caused the "reactions" when the specimen was apparently back in place, there seems no doubt in our mind.

Here was a clean-cut case of suggestion. Of course, our engineer friend made the customary electronic explanations and apologies. He explained that such a thing was bound to happen, because the doctor wanted to make no mistakes. Perhaps, all the while, the reactions were functioning correctly but they might have been wrongly reported by the doctor because he was anxious to make no mistakes. And so on, true to electronic style. The fact remains that there cannot be much real engineering work involved in a technique that is so uncertain and unstable as to be led astray by our simple maneuver.

Then there is an electronic worker—a non-E. R. A. worker, if you please, and proud of the fact—who volunteered to lead us out of the dark jungle of E. R. A. and into the open spaces, where we could get at the fundamentals and truth of real electronic medicine without further waste of time. Although it meant a long journey, we finally visited this gentleman and were rewarded by spending a pleasant day in his clinic and laboratory.

In the morning we started at the beginning of the subject. We were given demonstrations in which a little copper globe was made to spin about in a magnetic field, under the influence of a powerful light. The relative efficiency of a crude spark-coil current and a Tesla-coil current when applied to a geissler tube, was another feature on the bill. Peculiarities of sound waves served to pass an entertaining half hour. By easy stages we got to the crux of the matter—the all-important abdomen-rubbing.

"Did you ever see the reactions?" we were asked. "No. Many E. R. A. men have endeavored to demonstrate them to us, but so far we have never seen or felt them," was our sincere answer. "Well," said our guide in the great electronic field, "I am going to let you feel them so that you will be sure of it. I am going to elicit such strong reactions that the rod will be stuck fast to the reagent and will be pulled right out of your hand."

What a beautiful promise. Could it be, after all, that all our E. R. A. mentors, so far, were mere tyros at this work?

In the reagent's hand was placed a small glass tube, containing a human embryo just 21 days old, according to the label. "This little fellow throws off a male reaction, despite the fact he's dried up, petrified, if you wish, and surrounded by glass walls," was the preliminary announcement to this test. Then the doctor proceeded to rub the abdomen of the reagent with an amber-colored glass rod, first on the left side and then on the right. The rod, suddenly, began to stick on the right side—the male reaction area, according to the simon-pure Abrams doctrine. The rod would move down over the skin, suddenly stopping at a given point, and then resume its smooth glide to the end of the stroke. Then we tried it. Somehow or other, the rod refused to stick for us. We tried and tried and tried some more. Each time holding the rod in a different manner so as to secure the most delicate balancing of the rod to ensure the detection of the slightest change in the "pull" or "feel."

Meanwhile, there were present an E. R. A. (genuine) doctor and an electrical man doing development work for our host. Seeing

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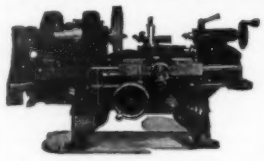

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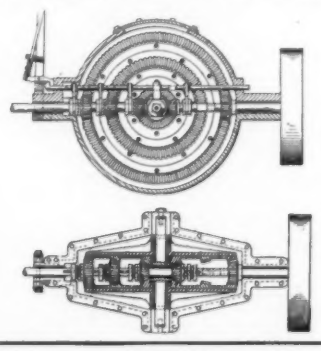

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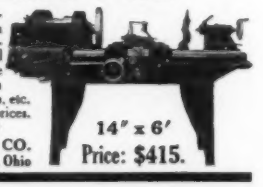

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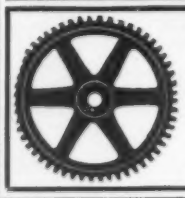

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our difficulties, both these gentlemen took the rod in due turn and proceeded to get the same results as our host. The rod stuck for them, but refused to stick for us. Other specimens were tried—neo-salvarsan, which should give the syphilis reaction good and strong, according to our guide's pronouncement; and a piece of cancerous tissue. Again the others present had no trouble in getting the reactions, while we scored an ignominious failure, finally bringing censure on our heads. Suddenly, the host exclaimed that the cancer area was blanching. "Look! See that crescent-shaped patch? It's the cancer area. That is a beautiful demonstration, the best I have ever seen. Do you see it?" Frankly, we did not. The skin of the reagent was rather pale all over, and almost uniform throughout. We did not see any crescent-shaped patch, although our host and the two other men present said they saw it and became quite enthusiastic over the fact.

The reactions were not so successful. Hence by common consent we turned our attentions to a study of the diagnostic apparatus and the treatment machine. Here again we found an attempt to introduce real engineering into the so-called electronic equipment. The diagnostic outfit was a business-like piece of work, while the treatment machine was quite capable of delivering some very real energy in the form of high-frequency current, produced by an oscillating vacuum tube. The precision with which the oscillator could be tuned so as to cause a maximum deflection on the hot-wire meter of the portable diagnostic outfit for any given disc setting was of interest to our electrical type of mind. It indicated exceedingly sharp tuning. But as to the value of the diagnostic and treatment machines from the standpoint of suffering humanity, we could not pass an opinion. Suffice it to state that all the while we had visions of those elusive reactions on which the entire structure here, as elsewhere, rests.

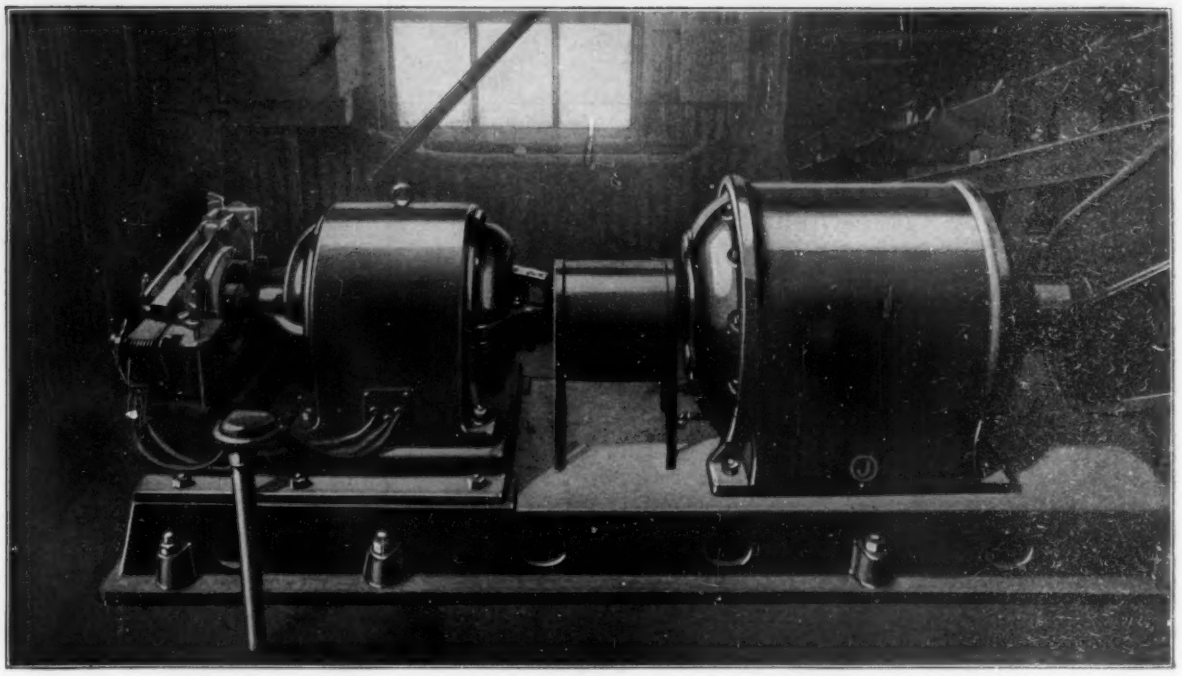
At the present writing we have under way a series of tests with a recognized body of competent electronic workers. While the members of this body have taken the Abrams course and are provided with genuine Abrams apparatus, they are not and will not call themselves E. R. A. men. The tests have for their main object the checking up of E. R. A. diagnoses on blood specimens taken at the same time from the same patients, with a view to seeing whether it is possible by means of this method to get the same readings for precisely the same blood specimens. Surely, nothing could be simpler or fairer. If we are to believe in the accuracy of E. R. A. findings, then it is reasonable to assume that the same blood specimens taken at the same time should give the same E. R. A. readings. In this manner we meet the objection to making comparisons with clinical findings, which, our readers will recall, are only 40 per cent accurate according to E. R. A. verdict, while E. R. A. findings, based on the same verdict, are 75 to 90 per cent correct. The results of these tests will be published at an early date. The tests will extend over a considerable period and will be of the most exhaustive character. Every opportunity will be given to the E. R. A. method to give proof of its most elementary basis in cold fact.

Meanwhile, we again extend our invitation to all members of the electronic fraternity to cooperate with us, to the end that we may get at the truth of this great controversy. The cooperation we seek is only such as the world expects from any serious and sincere body of men who are anxious to prove their case once and for all. Never again will E. R. A. and electronic medicine have this opportunity of securing a fair and sympathetic hearing. So far, the cooperation has been conspicuous by its absence, and for that reason our committee has been obliged to proceed quite unaided and, true, to tell, it has arrived at certain tentative conclusions which are not favorable to the electronic fraternity. Still, these conclusions, being purely tentative, are subject to change should the proper evidence be presented.

The Mooring Mast is the Thing

(*Continued from page 221*)

The tearing loose of "Shenandoah" due to a sudden dynamic stress suggests that we may go to the sea for another suggestion. To ease a sudden strain in the towing cables, powerful tugs make use of towing winches. These allow the cable to pay out when the pull exceeds a certain limit, taking it up when the strain eases up. The winches at the base of the mooring mast should embody this feature. This flexibility, coupled with a distribution of the cable stress over a large area of the ship, as suggested above,



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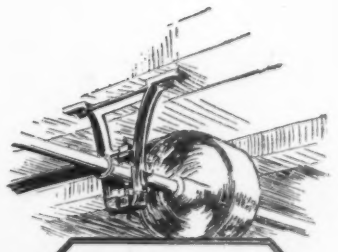

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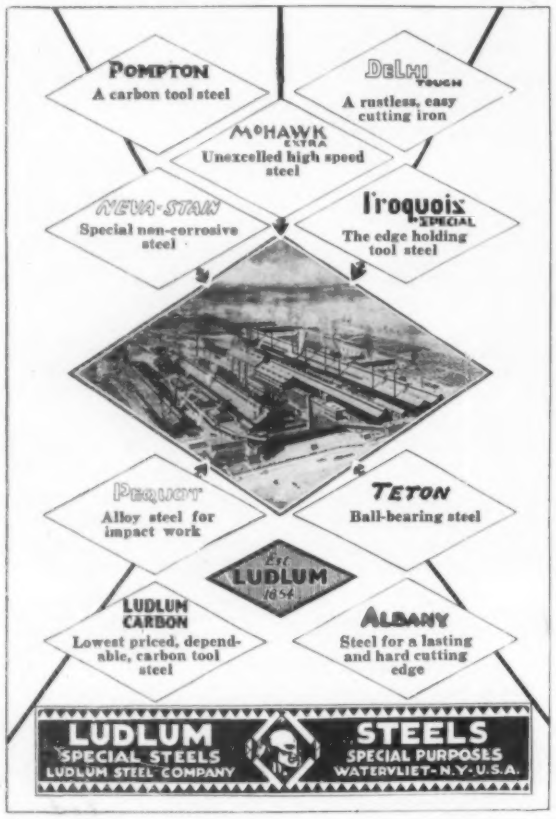

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would afford reasonable confidence that "Shenandoah" could ride out any gale that might strike her during her Arctic venture.

We present a picture of the mooring ship which will be sent north ahead of the "Shenandoah," whenever she makes her trip. A mooring mast carried on a vessel would be liable to swing considerably, even if the ship were in sheltered waters; for the effect of a sea reaches a long distance up any harbor or inlet. Consequently, it will be inexpedient to moor "Shenandoah" closely against the mooring mast, except for such brief periods of time as it may be necessary to do so. The movement at the top of a mast 175 to 200 feet above the water is considerable, even in a gentle roll.

The bridge of a destroyer rolling ninety degrees or more sweeps through the air, at the top of the roll, at a speed of over twenty-five miles an hour. Her bridge, however, is only about 25 feet above the sea. The top of the mooring mast will be, say, 175 feet above the water. The ship's period of roll would be slower; but the greater arc swept through would go far to compensate for this. If "Shenandoah" were riding transversely to the axis of the ship she would be alternately pulled forward and thrust back at a speed which, due to her weight of some 50 tons, would set up heavy inertia stresses which she was never designed to meet. If she were riding parallel to the rolling ship, she would be so heavily strained, transversely, that her girders might be buckled and the ship wrecked.

The officers in charge of the expedition favor the plan of letting the "Shenandoah," after she has been refueled, ride on several hundred feet of cable. The sag of the cable would act with a cushioning effect in heavy gusts of wind, and any rolling movement of the masthead would be damped out. Moreover, the "Shenandoah," riding high, would be in less danger of contact with the water or with the ship itself.

The Airplane and Archæology

AT the last meeting of The Archæological Institute of America, held at Yale University, Prof. R. A. MacLean of Rochester University read a paper of the above title. He said:

"Among the many services which the airplane is rendering at the present time not the least is the aid which it is giving in archæological discovery. In countries such as Mesopotamia where there are few maps to guide the archæologist, and in portions of Arabia which are difficult of access by ordinary means of travel, the airplane has already proved to be a valuable subsidiary help in making preliminary surveys, and in locating historical ruins and the possible sites of ancient cities."

By way of illustrating these points, Prof. MacLean gave two examples, drawn from his own experience.

"This last summer," he said, "I went by airplane from Amman in Transjordania to visit some Roman ruins at "Kasr Azraq" in the Syrian desert. Owing to the volcanic nature of the western portion of the Syrian desert this place had probably never been visited before by any archæologist in modern times. The ruins consist of an old Roman fortress of the days of Trajan. Another noteworthy feature was the presence on the oasis of about twenty pools of clear cold water surrounded by a Roman wall. It was interesting to observe that while this wall, only portions of which remain, could hardly be distinguished by an observer on the ground, its alignment and complete circuit of the pools could be seen clearly from the air."

Prof. MacLean's second illustration of the archæological utility of the airplane is drawn from his Mesopotamian experiences. Among the many lost cities of ancient times may be mentioned two which Xenophon speaks of in the *Anabasis*. Until quite recently the difficulty in determining the site of these two cities was due to the fact that the course of the Tigris in ancient times was not known to us. But by recent observations and photographs taken from the air it is now pretty well established that that portion of the Tigris which lies to the east of Xenophon's Median Wall had its bed about fifteen miles to the west of the present bed of the river. This can be determined with a degree of precision quite outside the understanding of one who has not seen for himself the way in which topographical features stand out when viewed from above. The depression seen from the air and the line of mounds along the depression were the clues which led to what is thought to be the discovery of the sites of both Opis and Sittace."

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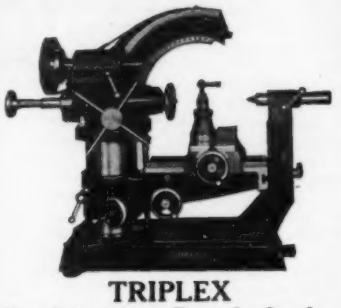

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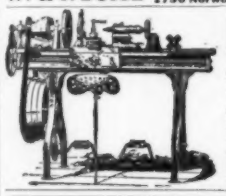

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Formaldehyde from the Elements.—Formaldehyde is one of the substances that can be manufactured from the elements, that is by the direct union of carbon acid gas and hydrogen. It has been found that this union is possible when a small amount of steam is also mixed with these gases. The mixture is then passed over a contact substance which is maintained at a temperature of approximately 240 to 250 degrees C. The products of the reaction are then condensed to give an aqueous solution of formaldehyde. The process is carried out in such manner that approximately two liters of the gaseous mixture are passed per hour through a contact space of about 750 cubic centimeters capacity. As a contact substance porous materials, such as unglazed porcelain, pumice stone, asbestos, coke, charcoal and artificially made carbon have been used to good advantage. The process has been patented in United States Patent No. 1,460,244.

New Drying Process.—A new drying process, which is known as the Kraus process, has been developed in Germany. This consists in spraying the liquid into a drying chamber by means of a horizontal rotating disc. This makes it possible to handle many substances which could not be processed in this way because they would clog the spray nozzle. The speed of the disc can be made so great that substances, which cannot be dried in any other manner, are successfully dried in this apparatus. The dryer has been used with success in the manufacture of powdered milk and is claimed to give an excellent product. It has also been employed in drying all kinds of colloidal solutions, extracts of drugs, active principles of glands, dyewood extracts, food solutions of all sorts, glue, gelatine, etc. For further details the reader is referred to the *Zeitschrift fuer angewandte Chemie*, volume 35, pages 533-5.

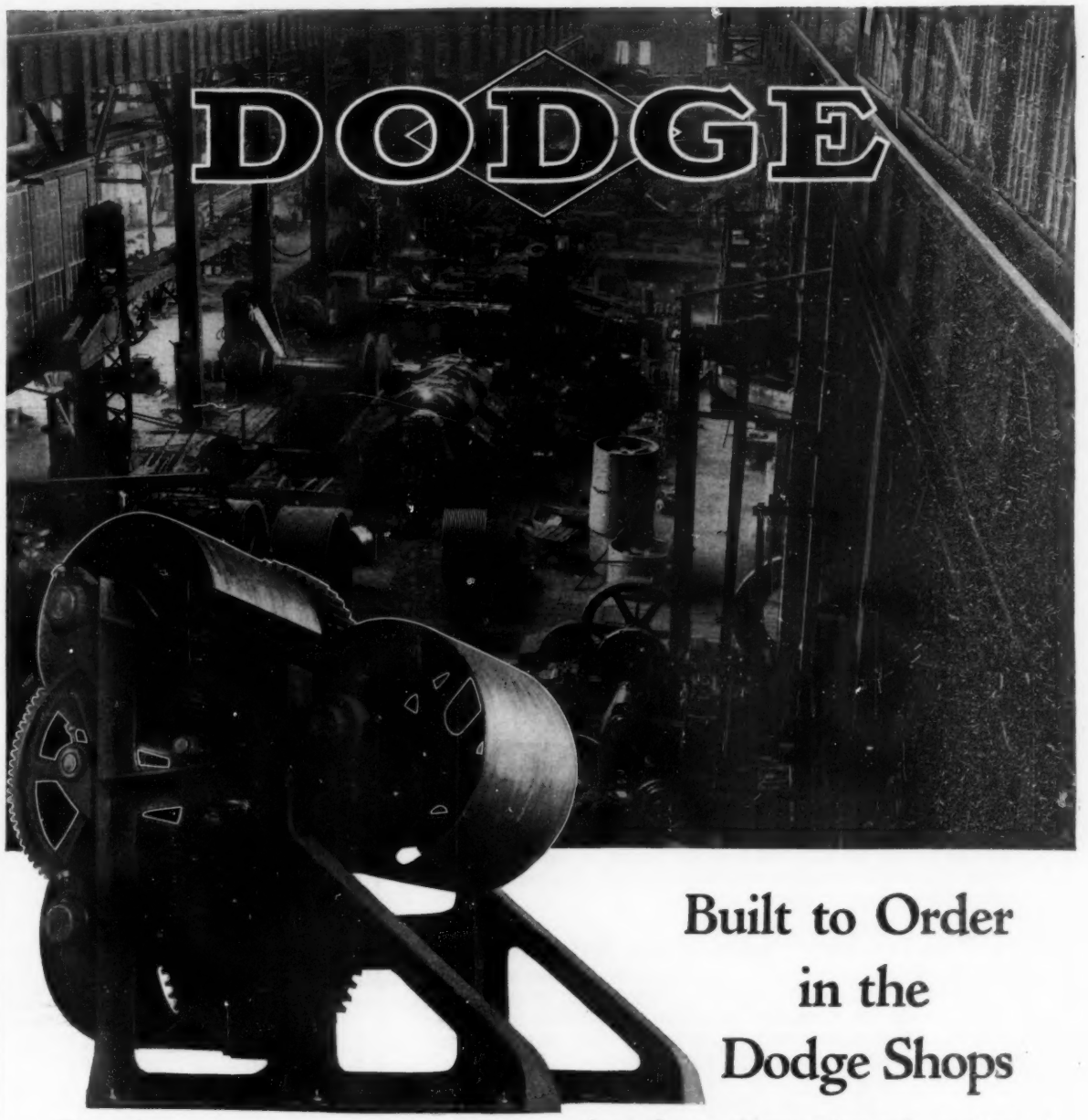
Cleaning Alabaster Articles.—There are various ways of cleaning alabaster articles, as, for instance, plunging them into lime water, washing them with white soap and rinsing carefully, rubbing with a pad moistened with pure benzine, etc. All these methods are good but attention may be called to the following one, which is recommended, especially when the articles are very dirty. Impregnate the article with a solution of oxalic acid and warm water and then rinse well. For further details see *The Oil and Color Trades Journal*, 1923, 1445 and *Moniteur de la Peinture*.

Glazier's Putty.—The following formula for making a glazier's putty is described in the *Revue des Produits Chimiques*. It is said to give very good results, as it adheres well and hardens perfectly. The putty is made by mixing together 30 parts by weight of china clay, four parts by weight of very fine iron filings, four parts by weight of talc powder and one part by weight of water. When this mixture is required for use, it is moistened with a 10 per cent solution of acetic acid.

Adhesive for Mother of Pearl.—Mother of pearl, horn and wood can be glued together by means of the following adhesive preparation. Glue solution at a suitable concentration is mixed with a corresponding quantity of strong warm vinegar, adding a certain amount of ordinary alcohol with a little alum. The cement, which is obtained in this manner, possesses a very great cohesive power, and will keep perfectly fresh in well-stoppered glass bottles. The following procedure may also be observed. For natural woods, make a cement of glue and sawdust. For mother of pearl and horn, use a cement based on powdered zinc white and floor varnish.—*Moniteur de la Peinture*.

Utilization of Leaves of Trees.—It has already been suggested many times that the falling leaves should be utilized. They are said to be used for the manufacture of paper, but most experiments and suggestions have been directed towards making leaves useful for food for animals. The "Versuchstation fuer die Konservenindustrie" in Brunswick, has been working on this problem and Dr. Serger has written briefly concerning the results of this work in *Chemiker Zeitung*. The foliage of a middle-sized tree weighs about 50 kilograms. If only half of this is har-

(*Continued on page 287*)



Built to Order in the Dodge Shops

This head drive for belt conveyor is but one of the many and varied classes of specially designed equipment built to order in the Dodge shops.

Complete piercing mills, rolling mill equipment, plate glass polishing tables, crushers, rope drives and other heavy machinery for all industries can be handled economically and with assurance of complete operating satisfaction.

Dodge facilities include a specialized engineering department—a large and well equipped wood and metal pattern shop—a foundry devoted exclusively to the production of large castings and a machine shop equipped for machining as well as a large erecting and testing floor.

If you are now contracting for your foundry and machine work or if you are building heavy special equipment in your own shops, consider Dodge—it may mean substantial savings for you.

Send us your specifications or let us give you further information.

To the Executive Responsible for Production

When your production machinery fails remember the Dodge facilities for emergency service on special equipment of all kinds. Our extensive, trained organization can be depended upon to deliver your job on time, ready to erect and to be placed in operation with minimum delay.

DODGE MANUFACTURING CORPORATION *General Offices:* Mishawaka, Indiana *Works:* Mishawaka, Ind., and Oneida, N. Y.

EVERYTHING FOR THE MECHANICAL TRANSMISSION OF Power

Branches: New York Philadelphia Pittsburgh Boston Cincinnati Newark Chicago Atlanta Minneapolis St. Louis Houston Seattle San Francisco

Meeting Emergency Demands of Industry

Gearing an Organization to Build Special Machinery Requirements in Record Time

Every executive knows that loss by fire, flood, wind or accident can never be covered in full by insurance carried. The cost of material may be recoverable in this manner, to be sure; but what about the loss from orders unfilled and shipments delayed?

In the past few months, the Dodge Manufacturing Corporation has had occasion to diminish the possible loss to manufacturers who have suffered shutdowns in the face of large numbers of unfilled orders. Dodge service in rebuilding special machinery and in pushing shipments of power transmitting units from centrally located stocks has made it possible for a number of plants to resume operations in the shortest possible space of time.

Toward the close of the year, a nationally known manufacturer suffered a devastating fire in one of his most important plants. While the ruins still smouldered, Dodge moulders were pouring the metal for units which would enable immediate rebuilding with a minimum loss of time.

A short time before, a great paper mill met with a breakdown. The following day, a Dodge branch manager had received and transmitted to the Dodge factories an order for 50,000 pounds of special forged shafting, bearings, sheaves, base-plates and pulleys. Sixteen days later, delivery had been made at the plant, located several hundred miles away, and a few days later the paper machines were functioning according to schedule.

Again, a few weeks ago, an automobile manufacturer experienced an over-time smash-up. The trouble came late on a Saturday, and the production schedule necessitated complete repair by Monday morning. Cars were pressed into service to round up Dodge machinists and moulders. Trucks were used to transport the material. The production schedule was resumed on Monday morning.

Dodge has set as its goal the perfect functioning in incidents of this kind. In the majority of cases, Dodge has attained this goal. Five hundred local dealers are prepared to furnish Dodge Power Transmitting Machinery on the immediate delivery basis. Back of them is an organization which is geared to build special machinery requirements in the shortest time possible.

One dial includes every adjustment—so simple anyone can operate it. Simply turning the dial brings in station after station instantly.

BRISTOL
SINGLE CONTROL
RADIO RECEIVER

Simple to Operate

The set for those who want results with little effort. Anyone in the family can quickly learn to operate it because technicalities and guesswork are eliminated—One Control Dial does it all.

Does Not Interfere with Your Neighbor

Other close by reception is not disturbed when you tune in with this non-reradiating Receiving Set. It gives you a comfortable sensation of freedom to be able to change from one station to another knowing that you will not interfere with your neighbor's receiving.

Choice of Aerial or Loop

Where conditions make it difficult to install an outside aerial, as in congested sections of cities, good results can usually be had by using Loop or short inside antenna. In fact, the directional feature of the Loop often brings in stations not possible with a stationary aerial.

Mounted in solid mahogany case with walnut finish, the Bristol Single Control Radio Receiver is handsome in appearance. The price is $190.00. Bulletin 3013-N describing this set will be mailed on request.

BRISTOL
TRADE MARK
AUDIOPHONE
REG. U. S. PAT. OFFICE
LOUD SPEAKER

This is known everywhere as the Loud Speaker with the quality tone. Not only is the tone natural and without mechanical distortion, but is sufficiently big in volume to be easily heard in a large room or all through the house. Comes to you ready to use—no auxiliary batteries are required.

MADE IN THREE MODELS:

Audiophone Senior	Price $32.50
Audiophone Junior	Price $22.50
Baby Audiophone	Price $12.50

MADE BY
THE BRISTOL COMPANY
WATERBURY, CONNECTICUT U.S.A.

Radio Notes

A Drop in Vacuum Tube Prices has recently taken place, much to the delight of radio devotees. Back in the early days of broadcasting, when a single-tube receiver was the height of ambition for most of us, the price of vacuum tubes did not make so much difference. But now that we have four and five-tube sets, every little drop in vacuum tube prices makes a great difference in operating costs.

Single-Tube Loud-Speaker Sets should be taken with a grain of salt. Of late there has been an epidemic of single-tube receivers for which the claim is made that they will operate a loud-speaker. In the case of the reflex single-tube sets, there is a possibility of operating a loud-speaker under favorable conditions, especially if the sets are carefully made with nothing but the best parts. Super-regenerative single-tube sets may also be made to operate a loud-speaker, but here the feat is accomplished at the expense of clarity and quality of tone. After all is said and done, the easiest and most satisfactory way of obtaining loud-speaker results is to build or buy a three-tube set.

The Interference Problem recently referred to in these columns is on a fair way to solution in the near future. The interfering spark transmitters of ship stations operating within the broadcasting wave length band are being transferred to a higher wave length well outside the broadcasting band. Meanwhile, other phases of broadcasting interference are being dealt with by experts, particularly radiating receivers. Manufacturers are being asked not to produce radiating receivers. Publications are being asked not to publish diagrams and instructions on the construction of radiating receivers. The public is being taught the necessity of making all receivers non-radiating, to the end that the shrieks and whistles and growls of the air may be disposed of in the very near future.

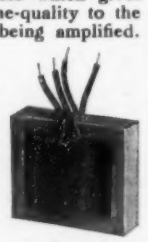
Spark Interference has been all but totally eliminated during the past month or two, thanks to the active work of the Radio Club of America and the cooperation of Government officials and radio communication companies. A recent conference in New York City resulted in the abolishing of the 450-meter wave sometimes used in ship-to-shore radio work. This wave fell in the middle of the present broadcasting band and caused some pretty mean interference for radio programs. Of course, this change helps matters a great deal—conditions had become almost intolerable in the vicinity of New York City, due to spark interference. However, it must be remembered that the ruling made by the conference does not apply to hundreds of foreign ships which will operate the same as before. Furthermore, many of our ships and shore stations are equipped with the old-style spark sets which will continue to interfere with broadcasting reception at short distance until such apparatus has been replaced by the sharply-tuned continuous-wave transmitters.

Phonograph Attachments for converting the usual phonograph into a loud-speaker deserve more attention than they have been receiving. When it is remembered that the better type of phonograph has a sound chamber over three feet long, and that its accoustical properties have been carefully worked out in the first place, it becomes obvious why a simple phonograph attachment can be made to deliver ample volume and sweet reproduction. Furthermore, the phonograph, being part of the furnishings of the usual living room, can be made to serve in the additional capacity of loud-speaker without detracting from the general appearance of the room. The receiving set, especially if it be of the crude, home-made type, can be placed in some remote corner of the house and connected up with the phonograph attachment by means of a twin-conductor cord. The writer of this column has his receiving set in a small study, while the phonograph arrangement is located in the living room some distance away. A small parallel cord runs from the receiving set to the phonograph by way of the backs of furniture and under the rugs, quite out of sight.

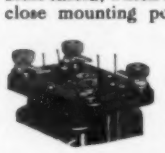
A Voice that Spoke to Fifty Millions.—The most spectacular demonstration of radio broadcasting and wire telephony, took place on the evening of February 8th, last. The ether and 5141 miles of telephone wires were joined together for the purpose of giving the greatest demonstration yet carried out by the joint use of telephony and broadcasting. It is estimated that 50,000,000 radio

A New Transformer —Built for Music

The correct design of the Kellogg transformer is a result of exhaustive study of sound waves and of the audio-frequency currents representing them, and has eliminated to the last degree the distortion of overtones which gives the tone-quality to the wave being amplified.



Our 25 years of experience, building transformers has developed a one piece silicon steel, laminated core; note the absence of punched holes, which so frequently cause loss of power. Not less carefully made is the brass shield, which makes close mounting possible without interference.



Note also how the ends of the windings are brought out and soldered in plain sight to the terminal posts; there are no concealed soldered joints.

Terminals plainly marked for connecting.

If your dealer or jobber does not handle Kellogg equipment, write us mentioning his name.

No. 501 . .	Ratio 4½ to 1 . .	$4.50
No. 502 . .	Ratio 3 to 1 . . .	4.50

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1066 W. ADAMS STREET
CHICAGO, ILL.

As a mouthwash—Germ-destroying, cleansing and refreshing.
As a gargle—Soothes and relieves an irritated or sore throat.
With a dentifrice—Gets at crevice-hidden food fermentation.
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After shaving—A delightful, first aid, antiseptic dilute lotion.

All druggists', $1.25 or postpaid. Liberal trial bottle 50c., postpaid.
W. F. YOUNG INC.
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THE ANTISEPTIC LINIMENT
for Cuts, Bruises, Sore throat, Strains, Chapped hands, Rheumatic aches, Sprains

Worthy of Their Reputation

Sheer merit, proven through the acid test of service, has won for Burgess Radio Batteries a world-wide reputation for quality, expert construction and superlative performance.

ASK ANY RADIO ENGINEER

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General Sales Office
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Laboratories and Works
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listeners heard General John J. Carty speak into the microphone in the Congress Hotel, Chicago. General Carty called the roll of seven broadcasting stations and twenty central telephone offices located at different cities across the United States. Telephone wires connected to the microphone led to radio broadcasting stations WEAF, New York; WJAR, Providence; WCAP, Washington; WMAQ, Chicago; KLX, Oakland; KTO, San Francisco; and PWX, Havana, Cuba, all operating on different wave lengths. This required more than 5000 miles of telephone lines, and 22,000 miles of emergency telephone lines were held in readiness to be switched into the big circuit between 10:30 and 11:15 o'clock in the case of a break in the wires. Fifty repeating stations were used in the network of wires. The test required the services of 242 telephone employes between the broadcasting stations. One hundred miles of cable was used under the Straits of Florida between Key West and Havana.

Trick Antennæ are very much in evidence these days, when the crowded city apartment house must accommodate a dozen antennæ or aerials on its roof. A number of ingenious inventors have seen fit to bring out trick antennæ which can be readily installed indoors or just outside the window, taking up little space as compared with the usual single-wire antenna. One of the best known of these trick antennæ is a coil of spring wire provided with two insulators, which can be stretched across the usual room. Because of the coil arrangement, this antenna is supposed to include a considerable length of wire in a short span. An improvement, so it is claimed, on this type is a double coil arrangement, with one coil inside another. One of the recent ideas in the line of trick antennæ is a small wooden framework with several coils stretched across, which is placed on the outside of the usual window. While all of these trick antennæ—for that matter anything in the way of an ungrounded wire—will give results with the super-sensitive receiving sets now available, the fact remains that nothing can take the place of the standard single-wire outside antenna. The short, indoor or outdoor trick antenna serves to sharpen the tuning considerably, but it also reduces the volume of signals.

What's in a Name!—Nothing is more confusing to the layman in radio than the multiplicity of circuits which confront him. With a market already saturated with circuits, there is a weekly crop of new ones to add further confusion to the art and to foment greater dissatisfaction against existing circuits, justifiably or otherwise. Yet the truth of the matter is that even at this late date there are very few circuits which are truly basic. Take the old regenerative circuit for example; week after week some ingenious experimenter or some enterprising radio merchandiser works out a new variation of that old idea and gives it some high-sounding name. From that time on we hear of the wonderful XYZ circuit which is smashing DX records. And all the while it is essentially the old single-circuit regenerative circuit which has been with us for the past three or more years. It is about time that the public should come to consider the essentials of radio, and to appraise all the so-called new circuits according to these essentials. Then, and only then, would the public realize that many of the new-fangled sets which cause such constant upheaval, are little more than our old friends, the regenerative circuit, the tuned radio-frequency amplifier, the super-regenerative circuit, the ultra-audion circuit, the neutrodyne, and the super-heterodyne in disguise.

The Radio Music Fund is a bold innovation in our radio broadcasting world. After having enjoyed free entertainment for the past few years, we are now confronted with the plea to contribute something toward a broadcasting fund, to the end that we may have the very finest talent available. The Radio Music Fund Committee is headed by Clarence H. Mackay, Felix M. Warburg, Frederic A. Juilliard, and A. D. Wilt, Jr., and has for its primary object the raising of a fund for the purpose of broadcasting concerts by the world's greatest artists. The members of the committee believe that radio offers a wide and hitherto undeveloped field for stimulating and increasing public interest in good music, and the committee hopes that through the Radio Music Fund it will be possible to afford thousands of people the opportunity of hearing the world's best musical talent. The committee has selected station WEAF to broadcast the proposed concerts. Arthur Judson, concert manager, will

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"

Eveready "B" Battery No. 766
22½ volts. Six Fahnestock Spring Clip Terminals, giving variable voltage from 16½ to 22½ volts, in 1½-volt steps. Length, 6¾ in.; width, 4⅛ in.; height, 3¾ in. Weight, 5 lbs.

Why Big Cells Count in Radio "B" Batteries

THIS handsome metal case Eveready "B" Battery No. 766 costs only two-thirds more than the smallest Eveready "B" Battery, but it *contains seven times the electricity!* This makes the No. 766 over four times as economical as its baby brother. That is why most people buy it.

Its fifteen large cells give 22½ volts of strong, steady energy day after day. Cells that pour out power the moment you turn on your tubes. Cells that rest well when idle, renewing their vigor for your next demands.

No cells have a bluer-blooded ancestry than these. They are the product of thirty years of dry battery research and development of the world's foremost electro-chemical laboratories. We think that No. 766 is the handsomest battery ever made. But that is a matter of opinion. It is a matter of engineering record, however, that this great standard "B" Battery has proved itself as perfect in performance as we are convinced it is superfine in appearance.

The 45-volt Eveready No. 767 contains the same large powerful cells as the No. 766. For maximum "B" Battery economy, therefore, buy the 22½-volt Eveready No. 766 or the 45-volt Eveready No. 767, as you prefer. Here is the "B" Battery at its best.

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Headquarters for Radio Battery Information
New York San Francisco
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If you have any radio battery problem, write to G. C. Furness, Manager, Radio Division, National Carbon Company, Inc., 216-218 Orton Street, Long Island City, N. Y. Informative and money-saving booklets on "A," "B" and "C" Batteries sent free on request.

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Eveready Radio "A" Dry Cell
Specially manufactured for use with dry cell tubes

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Variable taps
Fahnestock Clips

No. 771
"C" Battery
Clarifies tone and increases "B" Battery life

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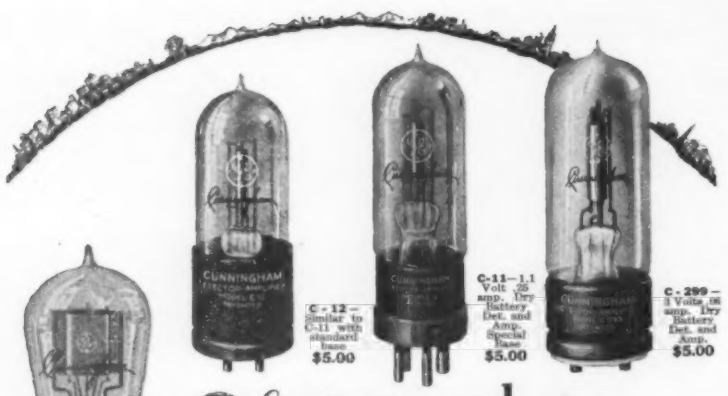
Radio Batteries
—they last longer


C-12—similar to C-11 with standard base $5.00
C-11—1.1 Volt .25 amp. Dry Battery Det. and Amp. Special Base $5.00
C-299—3 Volts .06 amp. Dry Battery Det. and Amp. $5.00
C-300—.5 Volts Gas Content Detector $5.00
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The complete line of Cunningham RADIO TUBES

FOR EVERY TYPE OF RECEIVING SET

WHATEVER type of receiving set or circuit you are using—one or more of these five Cunningham receiving tubes will be ideal for obtaining maximum distance reception with perfect reproduction of both voice and music.

C-299, the latest development in Radio Tubes, is compact in design and highly efficient in operation as a radio frequency amplifier, a detector and as an audio-frequency amplifier. The most remarkable feature of this tube is the new patented filament used which draws only .06 amperes at 3 volts.

C-11 is a dry battery tube with a special base for use in sets having special sockets. It is a good detector and audio-frequency amplifier. The filament is lighted from a single dry battery and draws .25 amperes.

C-12 is identical to C-11 in operating characteristics, but is mounted on a standard base to permit the use of a dry battery tube in sets equipped with standard sockets without the aid of special adapters.

Whenever storage battery supply is available for filament lighting, the C-300 will be the best tube to use as a detector because it is the most sensitive for the reception of distant and weak signals.

Under the same condition, C-301 A will be the best tube for amplification at either radio or audio frequency, because it gives greater gain per stage than any other tube on the amateur market. The new patented filament used, similar to that in C-299 draws only .25 amperes at 6 volts, reducing the necessity of frequent storage battery charging.

PATENT NOTICES.—Cunningham tubes are covered by patents dated 2-18-08 and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

The care and operation of each model of Receiving Tube is fully explained in our new 40-page "Radio Tube Data Book." Copies may be obtained by sending 10c to our San Francisco office.

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Here is a different, better book on Radio. It was written by Dr. J. H. Dellinger and L. E. Whittemore, Chiefs of the Radio Laboratory, U. S. Bureau of Standards, Washington, D. C. Ordinary books on radio grow old and out-of-date almost as soon as printed. Changes occur rapidly. Lefax gives them all, as they happen. You get all the new ideas, in loose leaf form, pocket size, beautifully, accurately illustrated. And you get a complete list of broadcasting stations, with full information about each one.

The binding is flexible imitation Morocco leather—long, long wearing and very attractive. Pages are most readable and are indexed with linen tabs, plainly marked. There isn't anything else like Lefax, by any name or in any form. Look into it. Ask your Radio dealer, book store or stationer for

LEFAX PERPETUAL RADIO HANDBOOK

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"Monitoring" in Broadcasting.—One of the very necessary tasks connected with broadcasting is that of "monitoring." In every first-class broadcasting station there will be found some young man intently watching the fluctuating needle of a meter, and constantly manipulating a control knob. This "monitoring" has to do with overcoming the wide variation in volume which must be handled in the case of certain musical instruments. For speech, the variation in average power is of the order of 1000 to 1. In music, and especially that such as given by a symphony orchestra, the energy variation between the softest and the loudest passages may be as great as 100,000 to 1. In the present state of the electrical art it is not practicable to handle such an enormous range of volume in broadcasting. This limitation arises not so much from the capacity of the broadcasting apparatus as from the existence of extraneous noise. The softest musical passages when broadcast must be made sufficiently loud to over-ride statie and other electrical interference in the ether, as well as receiving set noise and any incidental noise. When the softest passages are made loud enough to overcome such extraneous interference, it would be extremely expensive to provide the equipment for making the loudest passages 100,000 times as loud. Consequently, good broadcasting requires a skilled listener and monitoring device at the point where the program is picked up. The function of this listener is to adjust the amplifier in the broadcasting system so that its output will take into account the changes in the loudness of the program. These changes in loudness must not be unduly reduced, but they must be made such as will carry best to the radio audience without overloading any element in the broadcasting system.

What is the Super-Heterodyne?—Called the Rolls-Royce of radio, the super-heterodyne of late has been coming into its own. It still inspires a certain amount of awe among the radio laity, although, truth to tell, its complex nature has been greatly exaggerated. First of all, the super-heterodyne consists mainly of two members, namely, a frequency changer and a long-wave receiving set. It is based on the idea that a radio-frequency amplifier will operate easily on long wave lengths but not so on short wave lengths. It was Major E. H. Armstrong, the well-known radio inventor, who first decided to receive the short waves and then change them to long waves in order to obtain the high efficiency of long-wave radio-frequency amplification. Now the wave changer can be arranged as a distinct and separate unit from the usual receiving set. This device consists of a detector tube which receives two frequencies—the frequency of the incoming signal picked up by the antenna, and a frequency furnished by a vacuum tube oscillator called the "heterodyne," which feeds the detector by means of a suitable coupling. The output of the frequency changer has a frequency equal to the difference between the signal frequency and the frequency of the heterodyne oscillator. This difference can be varied by adjusting the heterodyne frequency. The difference in the two frequencies is impressed upon the intermediate radio-frequency amplifier. The super-heterodyne can be controlled by two adjustments, one for the wave length and the other to control the frequency of the oscillator tube. One is called the wave length control, and the other the frequency changer. To operate a super-heterodyne receiver the signal is tuned in as with the usual set. The incoming signal is then mixed with a signal or wave from the oscillator tube. The result is a signal of much lower frequency or, put it another way, much higher wave length. This low-frequency signal is then passed to an intermediate high wave-length radio frequency amplifier, and then on to the detector.

handle the engagement of artists for these concerts. The committee has designated the Central Union Trust Company, 80 Broadway, New York City, as depository of the fund. All contributions should be made payable to the Radio Music Fund, and should be accompanied by the name and address of the contributor. So far, according to reports, the response to the appeals of the committee has been most promising. Just what effect this innovation will have on broadcasting activities, no one can predict at present. It will no doubt hasten that evil day when broadcast entertainers will insist on payment for their services. And when that day arrives, it will become necessary for all broadcasters to revise their plan of operation.

AT LAST
Intermediate Radio Frequency Transformers

R-91

Now you can build a Super Heterodyne receiver with the confidence that you will have "The best there is." You can log all stations and select them at will, with clear loud speaker volume and minimum interference.

R-90

Branston Special Transformers have been designed for this work. Rigorous tests prove them far superior to anything heretofore available.

Our publication "Super Heterodyne Construction" makes it possible for the amateur to construct a complete and efficient Super Heterodyne Receiver.

Prompt delivery. At your dealer's or write for all information.

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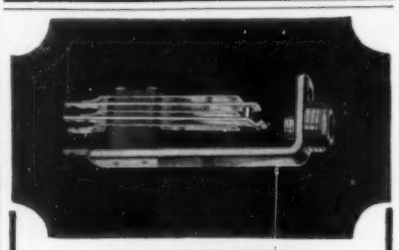

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Straits Settlements, Porto Rico, Canada, throughout the U. S. A.—and on steamships using waters of the various ports of the world—Unisol is being successfully used by those who are interested always to the point of maintaining first-class operating conditions.

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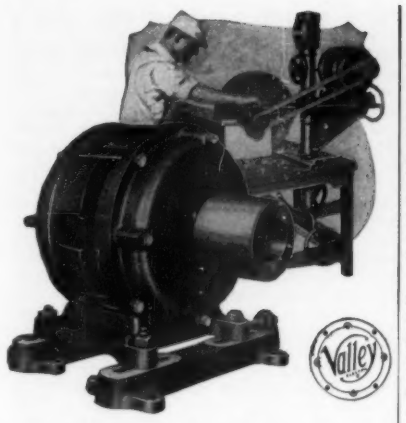

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Service of the Chemist

(*Continued from page 283*)

vested each tree will furnish 25 kilograms of green leaves. Green foliage gives an average of 33 per cent of dry substance. Then out of this leaf-hay which is first dried by the air and then artificially, a product is obtained which is similar to bran and can be used for food for animals. With a crop of leaves of 25 kilograms from one tree about seven kilograms of bran are obtained.—*Industrial and Engineering Chemistry*, January, 1924.

Use of Liquefied Sulfuric Acid in Industry.—As is well known, the purification of Roumanian petroleum has offered great difficulties, as it was not possible to obtain from it, as from Pennsylvania or the Caucasian crude oil, a satisfactory lighting oil through treatment with sulfuric acid. About twenty years ago the first successful attempt was made to purify Roumanian oil through treatment with liquid sulfuric acid. A special apparatus was designed which was found to be suitable for use in refineries of different sorts. Recent investigations show that liquid sulfuric acid can be used with advantage elsewhere in the industry. In the middle German lignite tar industry, hard and soft paraffines have been separated from the lignite oils by the aid of sulfuric acid, producing cold, stable oils. Greases can be separated in this manner from the materials which harden them and make them viscous. Petroleum products rich in sulfur are desulfurized in this manner, as also is anthracene refined.

Use of Glue in Coating Paper.—The Bureau of Standards is carrying out some experiments dealing with the use of glue in coating paper. Nine runs have been made on the experimental coating machine, using two makes of bone glue for either of the runs and a French casein glue for one. A good grade of English coating clay (Lee Moor) was used for all runs, and the results indicate that the water resistance of glue-bound coating containing chrome alum, compares favorably with that of casein-coated papers containing no formaldehyde. It is believed that the degree of water-proofing will prove sufficient for most of the papers used in half-tone printing. Difficulties have been experienced in obtaining a uniform coating, because of the variation in the fluidity of the coating mixture, and mechanical defects in the machine, so that additional work will be necessary before paper suitable for printing tests can be produced. See *Chemical and Metallurgical Engineering*, October 22, 1923.

Fuel Oil from Crank Cases.—The recovery of waste lubricating oil from the crank case of automobiles for use as a fuel oil has been the subject of recent experiments by a number of commercial garage owners in Boston. Steps for the regular collection and economical salvaging of crank case oil for fuel purposes are being considered. Objection that the waste oil was dangerous because of its dilution with gasoline has been answered by the statement that practically all of the gasoline has been evaporated from the waste oil.—*Oil Paint and Drug Reporter*.

Sterilization of Perserved Foods.—At a recent meeting of the Society of Chemical Industry in Newcastle, England, a very interesting paper was presented on the subject of the sterilization of preserved foods. The most important consideration in this respect is the penetration of the heat in the sterilization process. The use of preserved foods is increasing the world over and many chemicals are being used in the preservation process. It was brought out that though such chemicals, such as borax, were harmless in themselves, nevertheless, the use of them was to be deprecated because the accumulation of small doses in the course of the day was distinctly injurious to invalids and to children. The use of copper sulfate for greening peas was said to be absolutely reprehensible because it was a distinctly dangerous process, this salt possessing poisonous properties.—*Chemical Age of London*.

Red Stains On Brass.—Birmingham University in England has been giving particular attention to the question of red stains on brass and much investigation has been done in the attempt to discover the reason for this. Various possible causes such as the effect of segregation, the action of saline and acid deposits from the pickling solution and impure wash water, the influence of various qualities of rolling oils, the effect of iron and the effect of furnace gases were investigated. It is reported that the investigator said that the most important cause of stain-

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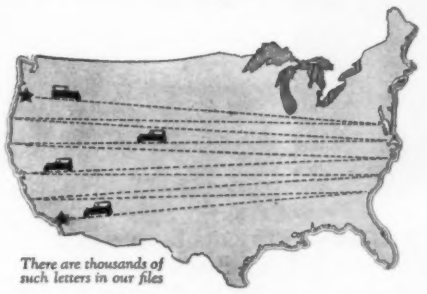

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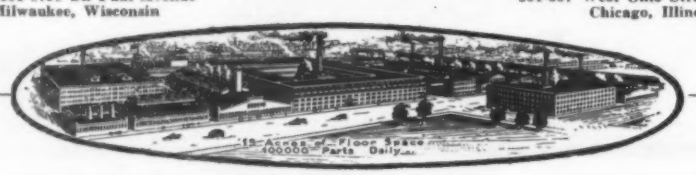

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ing lay in the use of old-fashioned furnaces in which the flames had direct contact with the metal. Red staining was seldom present before the pickling operation. It was formed as a result of reactions between the copper oxides in the scale and the pickling acid. Cuprie oxide was as harmful as cuprous oxide. The mechanism of red staining consists in the formation during the annealing operation of oxides of copper. The actual stain was formed later in the pickling operation.

Wood Paving Blocks Give Up Their Junk.—It is remarkable to see what an accumulation of junk can be found in old paving blocks. The metal trophies which become embedded in them include washers, screws, hairpins, nails, bolts and even coins. The traffic drives them in so that they cannot be dislodged by the street cleaners, and they stay there until the pavement comes up and goes to the junkman.

New Cigar Box Wood.—Spanish cedar may be supplanted as raw material for cigar boxes by a Philippine wood known as kalantas, if residents of the islands who are interested in the development of the lumber business there have their way. According to a report of the Philippine Forestry Service that has been received by the Department of Commerce, kalantas is practically identical with Spanish cedar from tropical America, and has the further advantage of being grown in a possession of the United States. Spanish cedar has heretofore been considered the finest wood obtained in the world for cigar boxes, but kalantas is said to be so nearly like it in color, texture and odor that only an expert woodsman can tell them apart.

"Artificial" Lumber Made.—Although none of the new artificial lumber has been marketed as yet, officials of the National Lumber Manufacturers' Association consider that tests already made of a synthetic composition produced by Minnesota lumber interests show it possesses many qualities making it available for structural purposes. In the process not only the trunks and branches of young trees, but the leaves and smaller parts as well are ground up and mixed with other substances, virtually eliminating waste. The resulting compound is capable of being molded into sizes and shapes of almost any description needed in building construction. From the time the standing tree is turned by the sawmill into planks and boards and applied in construction from 60 to 65 per cent has been wasted. This includes stumps, chips, bark and branches,, plank and log trimmings and a huge amount of sawdust. The new method will use all of this by-product.

Cinnamon.—The finest cinnamon bark is produced in Ceylon, where the Portuguese found the tree growing wild when they arrived in the island in 1505, says the *Bulletin* of the Imperial Institute. Since that date Ceylon has been famed for this spice, but owing to the small financial return it gives to the growers, much of the area under cinnamon in the island has been replaced by the more profitable cocoanut and rubber. Ceylon cinnamon, moreover, has had to compete, particularly in the Continental markets, with a cheaper product of coarser flavor from the Far East. Cinnamon bark reaches us in two forms: the ordinary "quills," used as spice, and "chips," which are distilled for the production of cinnamon oil used in medicine. The leaves of the cinnamon tree yield an entirely different oil from that of the bark; this oil contains eugenol (the characteristic constituent of oil of cloves) which is employed in the manufacture of vanillin, the well-known flavoring agent. Cinnamon-leaf oil is produced largely in the Seychelles, in addition to the Ceylon crop.

Untangling Our Automobile Laws

(*Continued from page 232*)

for the subsequent designation of such other Committees as shall be found necessary; they set regular quarterly meetings for the Conference; and they specify that business shall be done by the presentation to the Secretary of resolutions prior to the date of meeting. At later meetings the States of Maine, New Hampshire and Vermont were admitted; so that the present membership includes all the New England and Middle Atlantic States except Delaware, which has never displayed any interest.

The conference is simply a voluntary association of the motor vehicle administrators of the several States, to discuss common problems with the view of working toward common decisions and common policies. It has a definitely formulated policy that it take no action save unanimously. This is in no way a constitutional provision, but simply a working rule. It has never been violated, and the conference would of course go a long way before violating it. For most of the resolutions that come before the conference look more or less definitely toward new or altered legislation by the member States; and it is part of the game that the conferees go back home and urge upon their legislatures the measures that the conference has adopted. No commissioner could well go before his legislature and tell the law-makers that he was asking for a certain measure against his personal judgment, but on that of the commissioners of other States! The policy of unanimous action or none at all is practically forced upon the conference; and obviously any attempt to depart from it would start a lovely scrap. Incidentally, it has not yet been found to restrict the activity of the conference, to any notable extent.

The conference works mainly through committees. The ordinary procedure, when a resolution first comes up, involves reference to a committee—sometimes an existing one, sometimes one specially designated for the occasion. There may or may not be free discussion at this time, as the conference elects. There certainly will be such discussion when the committee reports. The resolution may be referred back to the committee at later meetings, without limit, thus keeping it alive during the attempt to overcome minority opposition. Ultimately the committee will be discharged by the unanimous adoption of the resolution, in original or amended form, or by failure to adopt or to recommit. Once it is adopted, the several commissioners take it home with them as part of their programs for future legislation, and do what they can to get through their legislatures any action which it may involve. In addition the conference has certain standing committees, such as one on headlighting and one that holds public hearings in search of grievances and suggestions, which originate business in committee, bringing it before the conference as it becomes in order to do so.

The conference has already to its credit one very large achievement. When it was organized, each State had its own headlight law, specifying the test which must be met by the front lamps on every automobile operated in the State. There was no uniformity at all; devices might be legal in one of the member States and illegal in others; for the tests in the various States were, if not in every case different, at least different in most cases. With the cooperation of the S. A. E. and the Illuminating Engineers' Society, the conference worked out what it regarded as a satisfactory test. Under the supervision of the conference and the societies named, this test has been applied to a large number of anti-glare lenses—the intent being to apply it to all that are actively marketed in the east. A list has been drawn up of some thirty-odd lenses that passed this test; this list specifies the candle-power of the lamp to be used with each lens, the focal adjustment, and the tilt. A law making legal the use of the lenses on this list, when properly adjusted, and incorporating into the code of the State the test used in drawing up the list, has been presented to the legislatures of all the member States. So obvious is the technical authority behind the measure, so obvious its benefits, that it has been adopted in every State. As a result, one can today drive anywhere north of the Potomac with the assurance that one's headlight is legal. Save that not all the States have yet specifically barred other lenses than those listed, so that certain lenses are still legal in individual States which are not legal in the others, there is in this territory absolute uniformity of headlight practice.

Even so, the conference does not regard the headlght issue as settled. Through the recommendations of the Headlight Committee, the conference adds from time to time to the list of acceptable devices. Also, the conference has recommended that the S. A. E. fix upon a standard form of focussing device, and that automobile manufacturers adopt such as standard equipment. And search is continuous for a more effective test than the one now in use.

Numerous resolutions have passed through the mill of the conference, but have yet to reach such general adoption by the member States as the headlight measures. One of these is that an operator's license law be made a part of the code in every State.

(*Continued on page 290*)

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Untangling Our Automobile Laws

(*Continued from page 288*)

Largely as a result of this, the New York legislature has under consideration and will probably pass a measure providing for such licensing; and removing the motor vehicle administration of the State from the jurisdiction of the Tax Commission and setting it up as an independent department in order to take care of the additional work involved.

In connection with universal licensing of operators, the conference is also on record in favor of the granting, to the licensing body or to other competent judicial or administrative authority, of the power to suspend or revoke both operators' licenses and vehicle registrations. In States having no operator's license this power automatically fails to exist; and not all the license States use it, while those that use it do not always define it clearly. There is, of course, every argument for and no possible argument against the use of suspension and revocation as a disciplinary measure.

The conference has adopted the right-hand right-of-way rule—that at intersections, in the absence of a traffic officer, the vehicle approaching from the right have the right of way. The experience of Connecticut indicates that the clause that makes this a part of the State code ought also to specify that no vehicle emerging from or entering a private drive ever has the right of way over a vehicle traveling on the public road. Most, if not all, of the eastern States have added this rule to their traffic laws.

Another resolution favors the strict enforcement of the law relative to the offense of operating a vehicle while under the influence of liquor. It is interesting to record a divergence of opinion here, which prevents any action by the conference more specific than this recommendation that the existing law of each State be enforced to the hilt. At least one of the commissioners is outspoken in favor of a change in the law which shall rob the trial judge of his power to choose between fine and imprisonment as a punishment for the drunken driver, leaving no other alternative than to send him to jail. Other members of the conference feel that in the presence of such a statute many conscientious judges would create another alternative, by acquitting people who were pretty plainly guilty but against whom the evidence left some loophole for doubt. This, of course, would defeat the purpose of the proposed measure, resulting in actual decrease of severity in dealing with intoxicated drivers. All members of the conference feel that this offense ought to be dealt with unmercifully; they are divided merely in seeking the best way to bring about the desired end.

Another divergence of opinion is covered by a resolution in favor of a law requiring "extraordinary supervision" over the driving licenses of all persons with physical infirmities. No attempt could be made to define these infirmities, for at least two reasons. Some of the commissioners regard deafness as a very large disqualification for driving, while others think that a prudent deaf man is about as safe a person as can be put at the wheel of an automobile. There is probably no general answer to this controversy, other than that it depends entirely upon the deaf man; it has been waged to a draw in several British automobile journals, and is constantly cropping up, in individual cases and in the general one. Certainly, however, it is fair to exercise "extraordinary supervision" over the deaf man who applies for a driver's license, and to demand from him proof of his qualifications much more rigorous than that exacted of a person with normal hearing; and the resolution as adopted covers this ground. Again, there must be an age at which one's ability to drive safely is no longer demonstrated by one's possession of a last-year's license, but may properly be questioned on each renewal. Here again, however, the precise year at which one enters the suspected class could never be determined for the general case—it would depend entirely upon whether the parties to the argument were themselves 60, or 70, or 80, or 90, or a full hundred. Epilepsy and drug addiction, the Connecticut statutes remind us, are among the disqualifications which the casual critic might not think of, or the casual observer see. So on all these grounds, the commissioners agree that any infirmity constituting a potential contributing cause to poor driving ought to get special attention from the licensing body; and that more specific than this, they cannot be.

At one time and for a short time Ohio was a member of the conference. Then a Mid-Western conference was started, and Ohio withdrew to join it. The Eastern conference, as the one we are discussing is now called to identify it, has a standing committee whose chief aim in life is to provoke the formation of other sectional conferences, and to cooperate with them after they are formed. It is hoped that ultimately the entire 48 States will be thus covered by five or six sectional conferences. Sectional uniformity will then proceed, as now, through action within these bodies; and nation-wide uniformity will be approached by dealings between the conferences. This should be much simpler than dealing separately with the individual States. Progress is being made in the extension of the conference idea.

We have commented, in a previous article, upon the discrepancy existing among the States in the lower age limit for operators. Incidentally, we were unlucky here. We required, as a horrible example, a State that had no age limit at all, and that adjoined a State having an age limit. We picked Nebraska and Kansas; and the former turned out to be the one State whose age limit we overlooked in digesting the 48 little booklets. It was there, quite plainly, and with prominent mention of the fact in the sectional title; but we missed it. Our only alibi is that if the book had had an index, we couldn't have missed it.

In the face of the divergent age limits now in use (14, 15, 16, 17 and 18 years, as well as none at all), it might be supposed that the representatives of ten States would be unable to agree upon a figure. Contrary to this expectation, the conference has passed a resolution favoring a minimum age limit of 18 for all States. Only one of the conference States has so high a limit—the commissioners do not let existing laws stand in the way of their adoption of what they regard as a wise measure.

A sensible idea is the resolution favoring a law in each State that shall make it possible for the commissioner to enter into detailed reciprocity agreements with other States. New York and New Jersey have already done this on the matter of their divergent age limits, but the agreement would be of doubtful value, without such authorization, if it were attacked in court. In general, the measure looks toward mutual toleration of the points of divergence which remain between the codes of the member States, and is therefore not so superfluous as it might seem.

The conference has gone on record as favoring the compulsory carrying of the operator's license on the person, and of the car registration certificate on the car. One would be permitted to question the wisdom of the last provision, as smoothing the way for theft.

All the member States require two license plates, front and rear; the resolution favoring this practice is therefore of significance only in connection with the possible extension of the conference idea to Florida, and to one or two other States who cars we occasionally see on Broadway with a chunk of cardboard doing emergency duty as a front marker.

A valuable resolution is one favoring a universal system of hand signals, and naming a committee to consider suggestions and report. There will be a wealth of these, and agreement upon one of them will be about as difficult a matter as the conference has tackled. A British authority of apparent standing has recently laid down a system involving no less than five different signals. We think it will be conceded that this is too many; but whether there will be general agreement with our own view (shared by at least one of the commissioners) that one signal is sufficient, we do not know.

Of great interest to the commercial owner and driver are the specific figures which the conference has adopted for maximum overall length, 85 feet; height, 12½ feet; width, 8 feet; and weight, 13 tons gross. That figure "85," by the way, is not a misprint; it is made so large in order to include truck plus trailer, projectng loads of poles or structural steel, etc.

And there we are. If we are to talk about uniformity of automobile and traffic laws, and strive toward such uniformity, it doesn't seem possible to find an agency through which the talking and striving may be more effectively done than through the conference of Motor Vehicle Administrators. The items which we have set down as having come under the consideration of the Eastern conference are but a small fraction of those which would have to be taken up and acted upon in the approach toward substantial, nation-wide uniformity. But the Eastern conference has shown the way; and it is to

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If your car is not mentioned here send name and model for particulars and our guarantee on it. AGENTS WANTED

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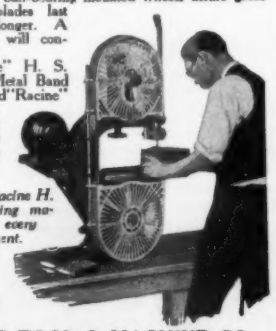
Use "Racine" H. S. Wood and Metal Band Saw Blades and "Racine" H. S. Tungsten Power and Hand Hack Saw Blades.



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be hoped that it will be imitated in other sections of the country.

Not alone in the actual record of the resolutions passed and incorporated into the laws of the several States does the progress made by the conference consist. The regular getting together of the commissioners and their exchange of viewpoints and experience counts heavily on the credit side. It paves the way toward ultimate agreement on points where agreement could not now be attained; and it leads toward improved procedure and uniform procedure in many items outside the actual purview of legislation. Thus, at their January meeting in New York, the members of the conference discussed various schemes for restricting the number of characters on the license plate to five for the smaller States and six for the larger ones—the greatest restriction that seems in the nature of the case possible. They discussed also the matter of colors for these tags, a very large problem when there is considered the necessity for a contrasting combination different from that in use by the same State last year as well as from those used by all adjoining States this year. They discussed and are now exchanging views and data on the points of what should be and what is covered by the motor laws of the several States, and how this content might be abstracted for publication in a form more intelligible than publication of the complete text gives. The office procedure used by those who have made the greatest progress in squeezing all the juice out of the registration records is always available for the guidance of those who have not utilized this resource to the uttermost. If one commissioner has unusual success in working out a novel and effective way of dealing with first offenders against the traffic law, the others automatically learn of it. And so on throughout the list of the things in which these commissioners have a common, *ex officio* interest.

Our Psychic Investigation

(*Continued from page 236*)

cream of the mediumistic profession.

In attempting to draw conclusions from this fact we are led in two directions. Any negative generalization which might be drawn from the failure of these second-raters to get anywhere, obviously lacks direct applicability to mediums in whose behalf a larger presumption of genuineness originally existed. On the mere face of the thing, no reasonable person would claim that our experiences have lent increased probability to the hypothesis that famous mediums like Kluski and the Schneiders and Miss Besinnet are frauds.

But this admission carries with it a large reservation. Our offer has not been restricted to the second-raters; it has been open to all mediums. Nor have we, as some disagreeable critics have claimed, purposely dug up second-raters to work with; we have been at very particular pains to insure that the investigation came to the attention of the first-raters. Their mere silence would be significant; but their inactivity is of a more positive type than mere silence. Direct or indirect overtures have been made to several of them, and these have been ignored entirely or given a cold shoulder.

In all fairness, we must confess that there is something to be said on their side; but, we believe, nothing in any way conclusive. For instance: many sincere believers feel that the offer of a money prize is so objectionable as practically to outlaw us. But we have pointed out that this is necessary to convince the public that our investigation is to be taken seriously. We have pointed out that the medium will sometimes be put to expense or actual loss by working with us, and deserves remuneration for this. We have in several instances stated that we would be willing to pay the entire prize, or the amount by which the prize exceeds the medium's expenses, to charity or to any designated beneficiary whatever or whomever, just so we pay it. This ought to dispose of the idea that the linking of these manifestations with money poisons our whole inquiry.

Then there is the matter of conditions and procedure. There seems to be a loose notion prevalent among the spiritists that these phenomena are not capable of being considered in cold blood, or tied down to definite conditons and definite examination—that in the bright light of reason, when the attempt is made to examine them critically, they fade into nothing. If this argument were advanced as tending to show that the apparently objective phenomena are in fact only subjective, we could follow it. But

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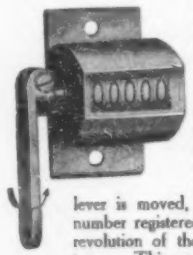

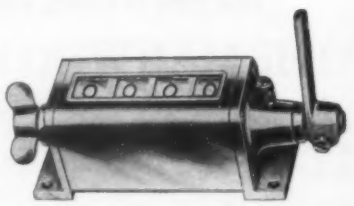

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when it is offered on behalf of the theory that they are objective but incapable of analysis, we fail to follow it. If these things happen, we do not and will not believe that they are in any sense miracles, contraventions or suspensions of the laws of nature. If they happen, they certainly happen through the operation of laws and causes as definite as those which produce a series of explosions in the cylinders of an automobile engine when the starter and ignition switches are closed. We are bound to believe that, given a repetition of the conditions, we shall have a repetition of the phenomena, in the psychic field as in that of optics or atomic physics or electricity or engineering.

Of course the conditions are complex. Of course they involve the human mechanism, and we are quite prepared to assume that they involve the physical and mental mechanisms of all those present. Of course it is on this account extremely difficult to say that in every essential detail the conditions at today's failure were identical with those at yesterday's success. But our investigators are neither children nor dilettantes; and we are excessively weary of having these truisms dinged into our ears by every occultistic Tom, Dick and Harry, writing to tell us just how to conduct and how not to conduct our work.

In our judgment, the main essential—granting for argument's sake that the phenomena occur objectively—is complete confidence between the investigators and the medium. Mr. Hamlin Garland, the novelist, tells of an investigation engineered by him, in the course of which 57 sittings (we *think* that is the number he gives, in spite of the suspicious coincidence with the pickle census) were held. At the beginning, the psychic thought that absolute darkness was vital, together with certain other conditions that were inimical to investigation. Mr. Garland found it possible to recede from these objectionable conditions a little bit at a time, putting each recession down as an experiment, until he had educated the lady to believing that she could work perfectly well in good light and with limitations in other directions which at first she would not even attempt to tolerate. He draws the conclusion that the conditions which are necessary are mostly those which the psychic believes to be necessary. He may be mistaken in his account of the very wonderful phenomena which he obtained in good light and under good control; but he certainly is sincere about it. And if the phenomena occur, certainly the way to provoke them is the way he used. We need not point out that we have approached each of our mediums in the same receptive attitude, and held it until we were forced to abandon it. If somebody will present us with a medium as worthy of patience and confidence as was Mr. Garland's medium, it will be extended.

It might not be a bad idea to remark here that we consider such procedure of tying the medium up, as was followed in the Pecoraro case, highly objectionable; but when informed that the phenomena consist in the manipulation of objects in the cabinet while the medium is tied, what can one do but tie him?

From the start we realized the extraordinary range of our work, and the impossibility of laying down in any detail conditions of seance procedure which should be applicable to all the cases that might come before us. We therefore refrained purposely from defining our conditions, save in the most general terms. We indicated that some sort of permanent, demonstrable record must be got of the psychic noises, the psychic lights, the psychic forms, etc. We indicated that this record will presumably be an instrumental one; we indicated that we shall employ ordinary scientific apparatus to observe the conditions of the room and the activities of the medium; and we gave a rough idea of the sort of apparatus to be thus employed. We pointed out that we must be able to give an account of the proceedings which shall carry the conviction that there has been neither fraud nor error. And that is all. We have indicated a complete willingness to discuss all proposed conditions and all proposed tests with the medium. In order that abandonment of procedures to which he might object would not necessarily imply the abandonment of the investigation, we have pledged ourselves to make every possible effort to find alternative tests and alternative conditions that will serve the same end as those found objectionable.

If a given medium were to come to us, outline his phenomena, and ask us to determine how we should test him, our response would give him grounds on which to base an opinion whether it would be worth while to attempt the production of his manifestations for us. But on the basis of what we have printed about our proposed conditions, no medium could possibly have ground for such judgment. Yet numerous mediums of rank have refused to have anything to do with us, on the explicit plea that psychic phenomena cannot be produced under our conditions. This can mean only that these mediums are unwilling to perform save under conditions dictated *in toto* by themselves. We draw no further conclusions; but the skeptic's conclusion is obvious.

One nationally-known psychic, about to be presented gradually to a group of investigators in close touch with our committee, under circumstances particularly favorable for building up confidence, refused to sit save in his own home, and even there refused to erect his cabinet elsewhere than in a corner where there is a door into an adjoining room. Another charges us with having transgressed our own conditions by employing, with "Mr. X," apparatus not known to the medium. The facts are that the apparatus in question had been approved by the medium; but that, in accordance with our terms, he did not know when we were going to use it. When a medium who is perhaps America's foremost takes the stand that at every moment the operator should know exactly what apparatus and tests are in use, one can hardly avoid wondering whether she is not interested in the persistence of mediumistic fraud.

One of the psychics who has said in so many words that his phenomena could not be produced under our conditions was driven, by another investigator, into a tight corner. The easiest way out was to plead that he had never made any claim which would deny that he himself does the tricks, subconsciously, while in trance. So he promptly made this plea. This medium, too, is one of the strongest bulwarks of the believers.

Something like a year ago, an influential spiritualist addressed his National Association, in convention assembled. We have not his precise words; but what he said was substantially this: "What are you going to do about the SCIENTIFIC AMERICAN investigation? Here is the best chance you have ever had to prove to the world that these things happen. If you do not take advantage of it, the world must and will conclude that you stayed under cover because you knew that you had nothing to show." Not alone did this fail to provoke any mediumistic response, but the Association actually took formal action advising its mediums against participation in our work. This puts the rank and file of spiritualists in the same position with reference to us—whatever that position may turn out to be—as the mediums. No plea can be made that any unsatisfactory outcome of our work is the result of mediumistic hesitation or mediumistic temperament alone. Their failure to collaborate is official.

Our investigation was not launched with the idea of embarrassing anybody. We were, in fact, naive enough to picture ourselves as seriously troubled by conflicting claims for precedence. But when fifteen months pass without a whisper from any high-grade medium, we are obliged to point out that if the conclusion of our work finds the believers in the uncomfortable position outlined above by one of their own number, it will be they themselves and not us who will have put them there.

We are aware of the fact that most of the prominent physical mediums are Europeans, and that the American ones are remote from New York. To remove the one serious material obstacle, we make here in public print an offer which we have already made privately to one or two of those named. This offer applies particularly to William Hope, Evan Powell, Franek Kluski, Erto, Willy or Rudi Schneider, "Stella C.," Frau Silbert, Mrs. Deane, Ada Besinnet, Mrs. Wriedt, and the Jonsons. Its applicability to the Schneider brothers, however, is contingent upon their presenting a satisfactory defence, in the event that a very recent newspaper story to the effect that they have been exposed in fraud is verified. On the other hand, its applicability will be extended to cover any medium other than those named, who makes it appear that he or she is worthy of inclusion in the same category. It applies specifically to an American lady of very large mediumistic repute who sincerely seeks anonymity. The omission of Eva C.'s name is solely on the ground that, from all reports, she appears a rather unsatisfactory person to work with; it is not to be taken as an expression of opinion on her mediumship.

To any medium named or qualifying, we will secure transportation to New York, in-

(*Continued on page 294*)

OUR ELECTRIFIED CIVILIZATION

In the Home

Air Heaters
Auto Engine Heaters
Automatic Ranges
Bell Ringers
Cozy Glows
Curling Irons
Fans
Fuses
Hot Plates
Irons
Mazda Lamps
Lighting Equipment
Meters
Micarta
Motors for
  Buffers
  Grinders
  Ice Cream Freezers
  Ironers
Motors for
  Sewing Machines
  Vacuum Cleaners
  Washing Machines, etc.
Newel Posts
Percolators
Radio Equipment
Rectigon for Charging Automobile and Radio Batteries
Safety Switches
Solar Glows
Table Stoves
Transformers
Turnover Toasters
Waffle Irons
Warming Pads
Water Heaters

In the Office and Store

Air Heaters
Bread-baking Ovens
Chocolate Warmers
Elevators and Control
Fans
Fuses
Mazda Lamps
Meters
Motors for
  Adding Machines
  Addressing Machines
Motors for
  Envelope Sealers
  Tickers
  Coffee and Meat Grinders, etc.
  Dictaphones
  Duplicating Devices
Panel Boards and Switches
Safety Switches
Ventilating Equipment

On the Railroads

Arc Welding Equipment
Automatic Substations
Baking Ovens
Circuit Breakers
Control Apparatus
Electric Heating Apparatus
Fans
Gears and Pinions
Generators
Headlight Equipment
Instruments
Insulating Materials
Mazda Lamps
Lighting Equipment
Lightning Arresters
Line Material
Electric Locomotives
Motor Car Equipment
Motors
Motors and Control for Shops
Pantagraphs
Power House Apparatus
Solder and Babbitt Pots
Stokers
Switches
Transformers

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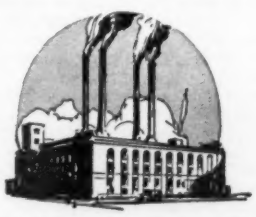
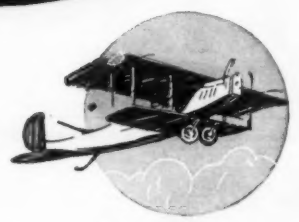
Lighting Power Plants
Motors and Control
Meters
Propulsion Equipment
Pumps
Reduction Gears
Switchboards
Turbines
Ventilation



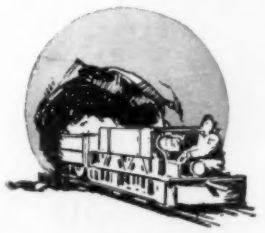
In Light and Power Plants

Circuit-breakers
Condensers
Control Apparatus
Fans
Frequency-changers
Generators
Instruments
Insulators
Lighting Material
Lightning Arresters
Meters
Motors
Motor-Generator Sets
Panels and Switchboards
Pumps
Relays
Synchronous Converters
Steam Turbines
Stokers
Switchboards and Switching Equipment
Transformers
Voltage Regulators



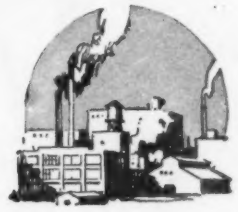
In the Air

Channels for Wiring
Generators for Heating
Generators for Radio Ignition
Micarta Gears
Micarta Propellers
Pulleys
Starting Motors
Stream Lining for Generators and Struts



In Mines

Arc Welding Equipment
Automatic Starters and Controllers
Automatic Substations
Battery Charging Equipment
Circuit Breakers
Electric Heating Apparatus
Fans
Gears and Pinions
Headlights
Insulating Materials
Mazda Lamps
Lightning Arresters
Line Material
Locomotives
Motors for Hoists, Pumps and Tipples or Breakers
Motor Generators
Portable Substations
Switchboards
Synchronous Converters
Transformers
Ventilating Outfits

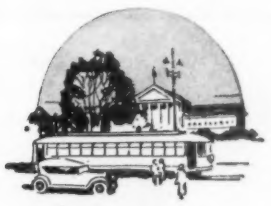


In Mills and Factories

Arc Welding Equipment
Automatic Starters and Controllers
Circuit-breakers
Fans
Furnaces and Ovens
Fuses
Glue Cookers
Insulating Materials
Knife Switches
Lighting Equipment
Locomotives
Mazda Lamps
Meters
Micarta Gears
Motors
Panels and Switchboards
Power House Appartus
Safety Switches
Space Heaters
Static Condensers
Stokers
Transformers
Ventilating Equipment

On the Farm

Curling Irons
Fans
Fuses and Fuse Boxes
Irons
Mazda Lamps
Motors for all Home Appliances
Motors for Power Purposes
Out-door Switch Houses
Percolators
Power Stand
Radio Equipment
Switches
Toasters
Transformers
Waffle Irons and the Westinghouse Light and Power Plant



On the Street

Street Railway Equipment

Arc Welding Equipment
Automatic Substations
Babbitting Outfits
Babbitt Metal
Baking Ovens
Circuit-breakers
Control Equipment
Fans
Gears and Pinions
Insulating Materials
Lighting Arresters
Lighting Fixtures
Line Material
Machine Tool Motors
Mazda Lamps
Motors
Portable Substations
Relays
Solder and Babbitt Pots
Switches
Transformers
Trolley Poles

Street Lighting Equipment

Cables and Conduit
Control Apparatus
Mazda Lamps
Ornamental Posts
Street Hoods
Transformers

Automotive Equipment

Ammeters
Generators
Ignition Equipment
Lighting Equipment
Mazda Lamps
Starting Motors
Switches
Timing Gears
Voltmeters

Westinghouse

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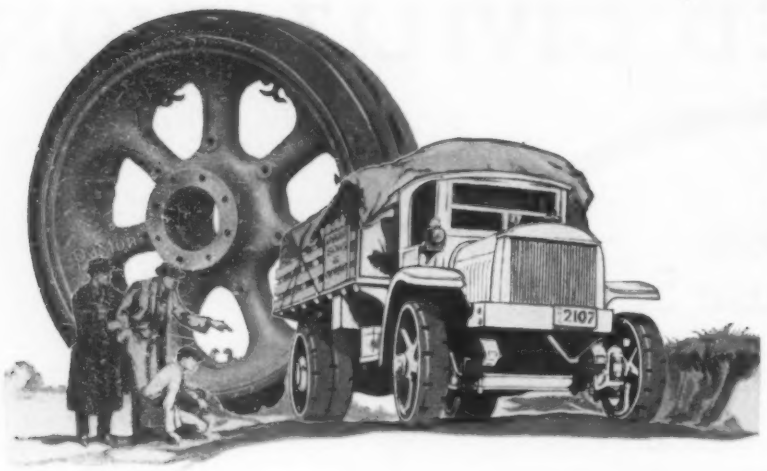

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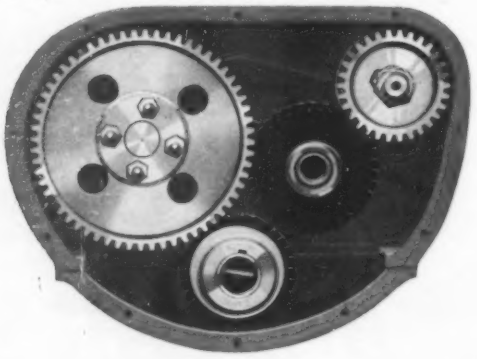
Dayton
Steel Truck Wheels



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FORMICA
Made from Anhydrous Bakelite Resins
SHEETS TUBES RODS

Our Psychic Investigation

(*Continued from page 292*)

sure adequate maintenance while here, and procure return passage home at the end of the sittings—subject to reasonable advance assurance regarding length of stay and acceptance of tests and apparatus whose use involves no danger to the medium. We will give all reasonable assurance of good treatment. If either or both of our $2,500 awards are won as a result of this offer, we shall deduct the amount thus spent; if they are not won, the financing of the investigation will be our loss. And in self-defence, we must specify that we cannot hold this offer open to late applicants, after it has been accepted by any early comer. It will, however, not be withdrawn on any other ground than that it has been accepted, or that our award has been won; and if circumstances justify, we will extend its benefits to more than one applicant. It will expire by limitation when our original offer expires; if the original offer is extended, the continuance or discontinuance of this supplementary one will be specified.

Little Fishes and Big Oil Pools

(*Continued from page 244*)

the University of Pennsylvania, Dr. Joseph Leidy, one of the most active of early American Scientists.

"Fully forty years ago," says Dr. Macfarlane, "Dr. Leidy pointed out that the escaping oil from the Philadelphia gas works when passed into the Schuylkill River gradually became caught up between mud particles, and then the whole was precipitated as an oil clay film to the bottom, where it became the foundation for oil shale or clay. This was later confirmed and extended by Stuart, the Anglo-Indian geologist, in his experiments with Burmese petroleum."

Going into this in more detail, Dr. Macfarlane found that the mud takes up the oil, two fine particles of mud and one particle of oil generally being found together. But the final proof that earth oil comes from fish is found in the fact, generally known to geologists, that deposits of fish bones and scales are always found in or near all known oil deposits.

"I have taken the information on which my statements are based from authentic scientific records," says Dr. Macfarlane, "at the same time that I have studied oil shales in the fields from which such supplies are directly obtained. These show that throughout the world, wherever oil is found, there is a so-called bone-bed or fish-bed or fish-and-oil shale stratum, ranging in thickness from a few inches to several feet. Some of these consist wholly of fish bones or other remains, and each such deposit represents a tremendous slaughter of fish by some prehistoric earth cataclysm.

"Oil is now being found by geologists, but for some reason no one heretofore has connected the prevalence of fish-bone deposits and fish oil with the finding of petroleum or rock oil. Yet it is a fact of scientific record that wherever there is oil there are these deposits, stretching in some cases for hundreds to thousands of miles. In some of them the explorers have found embedded perfect skeletons in such numbers as to indicate deposits of millions of fish.

"The question will arise, how are these fish killed. Nearly every person is familiar with the fact that a severe shock in the water kills all fish within reach, by vibration. In the area of greatest intensity of an earthquake the slaughter of fish is beyond computation. Coast lines are altered, also, and either by that process or by upheavals of the bed of the sea, millions of fish may be killed instantly and buried. It is then only a matter of a few weeks until the oil has been forced out of them into the surrounding shale, by pressure and decomposition, so that the shale then becomes a 'producer' rock. The oil often migrates, however, to adjacent strata which may then become reservoir rocks or sand. This process goes on all the time. It is not necessarily confined to earthquakes. We do not need to list all the causes of death to fish. It is necessary only to consider the vast area of the sea, the teeming multitudes of known specimens of fish, the known yields of oil to realize that the waters of the earth constitute an almost limitless distillery for the production of crude petroleum.

"There is every promise of great and sufficient oil supplies for the future, especially if present known oil strata are penetrated to increasing depths, but in continuing anticlinal relations. Increasing utilization also of oil shale rock will furnish practically ex-

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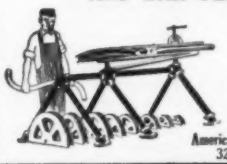

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haustless supplies for many countries where these are found. Its extraction at reasonable cost should be one of the problems that inventive science should solve. A skilled scientific staff of geologists and paleontologists should have wide and accurate knowledge of fossil fishes and even fragments of them, so that when definite areas are investigated it may be possible to locate and follow the important oil bearing zones along with any by the aid of their typical fish fauna."

How Gold Leaf is Made

(*Continued from page 244*)

original one-inch square of rolled sheet. A pack is then made out of a thousand sheets of leaf, interleaved as before between sheets of goldbeater's skin, and this is again beaten with an eight-pound hammer. Final size of the leaf is five inches square. The last beating operation lasts on the average twelve hours, dependent on the weather, and the steadiness of the eye and arm of the beater.

The finished films are laid on calf skin cushions and cut with a little device, made in the form of a bob-sled from lacquered Japanese cane. Strips of malacca reed are glued into the runners and serve as the cutting edges. Great care must be exercised in this operation for the extremely thin films of gold are easily torn. The fineness of these leaves of gold is demonstrated by the fact that they can be torn without any difficulty at all by blowing the breath across them. After being cut, the leaves are placed in books, made of tissue paper and coated with ochre. Twenty-five leaves are found in each book.

The entire duration of the gold leaf process is 35 hours. The whole thing is a matter of beating, pounding a heavy hammer to spread the gold into a fine film and at the same time using great skill to avoid tearing holes in the sheet. Gold leaf is used in making signs, but it also has a few additional applications. Handtooled books are usually lettered in gold leaf, and furniture and fine woodwork are decorated with it. Its sole technical or scientific use seems to be making the electrical instrument, known as the electroscope, which is used for detecting static electricity.

Gold leaf is not to be confounded with gold foil. The latter, used by the dentist in filling teeth, is very much thicker than gold leaf. A sheet of gold foil, four inches square, weighs from four to twelve grains, while 25 sheets of gold leaf of the same size weigh approximately five grains.

New House Bill Aimed at Patent Frauds

IN JANUARY, Representative Lewis C. Crampton, of Michigan, introduced H. R. 5790, whose salutary purpose is to prevent fraudulent, deceptive, and other improper practice in connection with the prosecution of patent applications before the United States Patent Office. In urging his bill, which deserves every support, Representative Crampton said that, in Washington and a number of other places throughout the country, individuals, firms and even corporations are acting as patent attorneys and inducing clients to entrust important patent business to them with the idea that they are authorized to practice before the Patent Office; and he also suggested that in several instances attorneys who have been disbarred from practice before the Patent Office are practicing under cover, while other men who have never been registered, and who are not entitled to be registered, are representing themselves as patent attorneys and taking fees as such. He incidentally calls attention to a case wherein one of his own constituents was led to pay some $1500 to an association not registered, but practicing, and not having any right to practice. The purpose of Representative Crampton's bill is to prevent anyone from practicing directly or indirectly, before the Patent Office who is not registered to practice, or who has been disbarred.

The Senses of Bees

THAT bees are color blind as people sometimes are, and that they learn their way about by perience rather than by instinct is the conclusion reached by Prof. F. Frisch and Lothar Tirala, German biologists, who have made a careful study of the insects. These investgators have shown that to the bee, red and black look alike, orange and yellow look the same as green, and that there is no difference in the appearance of blue, violet and purple. But bees have one advantage over man; they can see the rays of ultraviolet light, which are invisible to our eyes.

It was also discovered that the mysterious guiding influence by which the bee is brought

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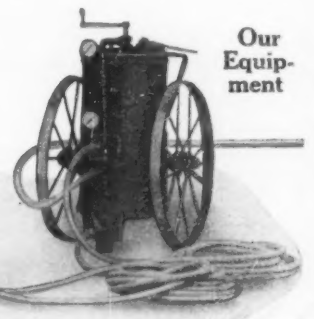

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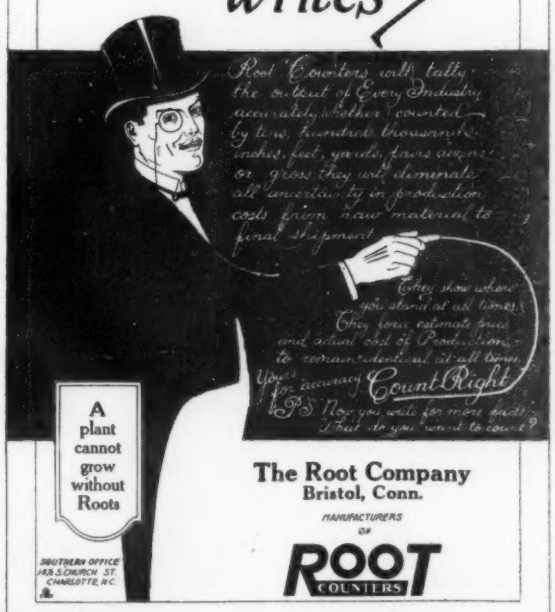
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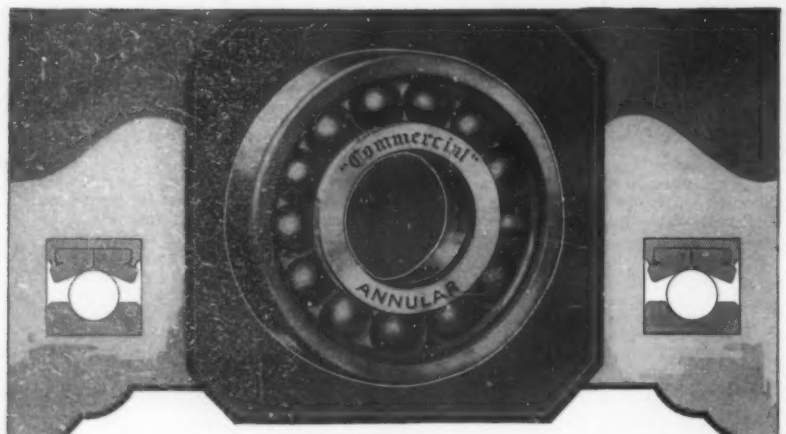

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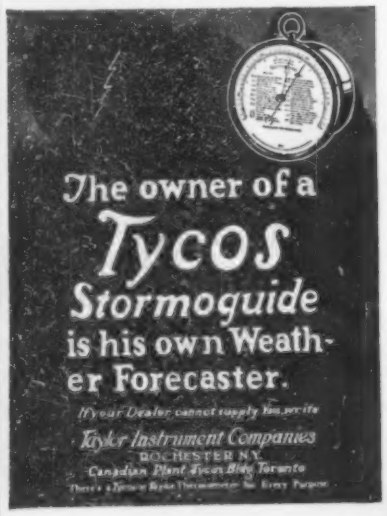

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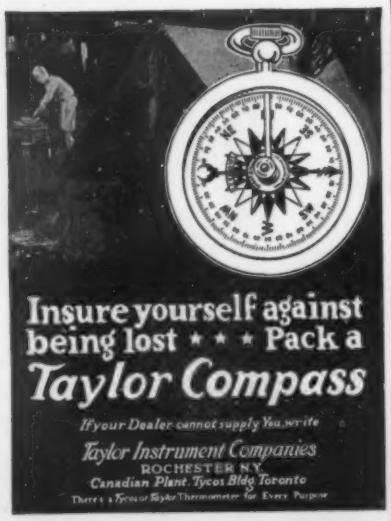

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back to its hive is nothing more than experience. It has long been known that bees find their way home sooner the longer they have lived in their hive. To test this common-sense view bees were put to sleep by ether, taken to a new hive, and moved some twelve yards away. None of them could find their way back to the hive until the third day afterward, when 30 per cent got home. By the eighth day, however, 90 per cent of them had learned to find their way back to the hive.

Man-Made Lumber

(*Continued from page 250*)

thoroughly cemented to this blanket. This makes the blanket of increased strength, water and moisture resistance, and renders it absolutely impossible for any air currents to pass through it. The final step in the manufacture of balsam-wool consists in trimming and slitting the blanket into such widths and lengths as are desired, after which the blanket is rolled up into bundles and is ready for shipment.

Thus, it will be noted that in the manufacture of balsam-wool certain steps in the paper making art have been made use of, but the individual fibers have been fabricated by an entirely new formation in order to get the low density and high heat resisting properties desired. The new product is not paper; it is of a truth, as our title implies, artificial lumber.

Owing to the remarkable lightness with which the wood fibers have been rearranged, balsam-wool has found a ready sale wherever it is desired to prevent heat losses, especially in the insulation of houses, cars, etc. Homes, for example, insulated with balsam-wool, of which a great many have already been built in the Middle West, are not only more comfortable to live in, but can be heated with a saving of over 30 per cent in the amount of fuel ordinarily required.

The second product more recently developed at Cloquet is quite different from the balsam-wool just described, although it is made from the same raw cellulose material. This product, to which the trade name nu-wood has been given, is a dense solid mass of tree fibers pressed together into boards 4 feet wide by 16 feet long and varying in thickness from ⅛ to ⅝ inch. These large boards are then resawed into smaller boards of any size desired. Since the process starts with the individual fiber just as in the paper industry, it is possible to use the natural wood in any form or size whatever. In fact, the process uses sizes and forms of wood even too small and crooked to be ordinarily profitable to the paper maker; thus slabs, edgings, sawdust, trimmings, etc., make an ideal raw material for the manufacture of nu-wood and from them is made a finished product which can be sawed, nailed, sanded and finished like natural lumber, but with the added advantage that it warps less and has no defects such as knots, shakes, pitch pockets, worm holes, etc. In the lumberman's vernacular, nu-wood is all "F A S" or clear on all sides.

In the manufacture of nu-wood the sawmill offal is first chipped to small particles and is then treated with an alkaline solution but not to the same degree as in the manufacture of balsam-wool. The alkaline treated chips are then ground mechanically in the presence of water, so that they are torn to pieces and the structure of the individual cells in many cases is completely destroyed. In this condition they are sized to render them waterproof and are then flowed in a current of water on to a screen and subjected to heavy pressure to force out the water. The pressure reduces the mass of fibers to a stiff board-like cast of wood, which is then subjected to heat so that the remaining moisture is reduced to about six or eight per cent. The final result is a stiff, strong, dense board of wood fibers, so intermingled and interlocked that the synthetic product has none of the grain characteristic of natural wood.

Nu-wood is designed to compete with lumber for such purposes as furniture cores, boxes, wood trim, panel stock, etc. It takes paint as well as natural wood and as it holds glue most tenaciously, it makes an excellent base for veneer stock.

Bombing the Battleship

(*Continued from page 252*)

ship fleet is attacked by airplanes the attack comes with such suddenness, that the airplanes, which are "tied" to the ships and carriers, cannot possibly get warmed up and into the air before the attack is over and the attacking craft have flown far from the scene. The power of position! It takes time for the airplanes of the battlefleet to gain the same altitude as the attackers, and until they have gained this altitude they are useless. It would be only a rare and fortunate occasion on which the airplanes that were being carried by the battleships would be hovering fifteen thousand feet in the air waiting for a supposed attack. For scouting and observation purposes small airplanes or balloons could be used with advantage by battleships; but a fighting force of aircraft tied up with a water fleet would certainly appear to be of little defensive value against aerial attacks. A battleship might as well take along submarines to combat enemy submarines.

Above all it must be remembered that bombers can now operate at *low altitudes*. There has been very little said about this! But the bombing tests that took place off the coast of North Carolina last September opened the eyes of observers who saw it. The smoke screen and smoke bombs now make it possible for a fleet of airplanes to attack a fleet of battleships from the extremely low height of five hundred feet at point-blank range.

The strategy can be worked in this way. Two or three fast and small airplanes may drop from a formation that is approaching or has not yet come in sight of the battleships, and circle the targets with smoke screens, or curtains. Their speed of about 200 miles an hour would provide a humming bird sort of a target to anti-aircraft gunners. The bombers following up could sweep down behind the screen, break through at an unexpected point, drop the bombs upon their targets and disappear behind the smoke screen on the other side. The anti-aircraft gunners have had to sweep their pieces through an arc of about 180 degrees within a few seconds and do it amidst the bursting of shells, and probably with burning phosphorus (see illustration) running down their necks. This maneuver was not carried out last September; but it was apparent that it could easily have been done. Many expert observers were of the opinion that a formation of bombers could burst through that heavy white wall of smoke and attack at a low elevation.

In such an attack the first attacking planes would be of the fast type, carrying lightweight poisonous gas or liquid-flame bombs, which they would drop upon the battleships. This would force the personnel into gas masks, or below deck, so that manning the anti-aircraft guns would be out of the question.

Although anti-aircraft fire can never be entirely overlooked or minimized by airmen, means are available to make it ineffective, such as armor, altitude, smoke, poison gas, and liquid fire. An attack through smoke can get carried out with still greater safety, by airplanes dropping smoke bombs from a great height, a half mile or more from a fleet of battleships, in such a position that the wind would blow the smoke over the ships, shutting off horizontal and vertical vision, but still enabling aircraft to spot them amid the haze. It has been learned from flying that a heavy ground mist which greatly obscures vision from the ground can be easily seen through from the air when a little altitude is gained.

Great bewilderment would be imposed upon a fleet of battleship commanders, if they were suddenly plunged into a smoke fog while they were steaming in formation, and tons of bombs to begin raining upon them from above—bombs of gas, fire and explosives. Random or fleeting shots from anti-aircraft would be of little value. The aircraft, tied to the battleships, could not take off in the smoke with safety. These smoke bombs, too, would no doubt contain poisonous gas. It is rumored that a bomb has been developed in Europe, containing a heavy gas that eats into the flesh like strong acid, and that another has been tried out that contains liquid which eats into steel as hydrofluoric acid into glass.

Another possibility of attack was apparent last September. In the early morning low clouds hung over a glassy sea. It would have been easy for the fleet of attacking bombers to approach their targets just inside these clouds and, after dropping their bombs from the cloud haze which would partly have hidden them from the anti-aircraft gunners on the battleships, to have swung up into these clouds, where they would have been practically immune from gun fire. With the staunchness of modern airplanes and the development of navigation instruments, foul weather, such as low-hanging clouds and winds that churn up choppy seas, forcing gunners to fire from an unsteady deck, become a positive ally of the aviator.

Charles Allen Munn

IT IS with deep regret that we have to record the death of Mr. Charles Allen Munn, the late President of the Scientific American Publishing Company, in the sixty-fifth year of his age. Born, on May 22, 1859, the second son of Mr. Orson D. Munn, one of the original founders of the SCIENTIFIC AMERICAN, Mr. Munn carried on the traditions of the family by devoting his life, with unflagging zeal and enthusiasm, to the interest of this journal. His associates in this office will not soon forget with what courage he continued to come to his desk, in spite of a partial stroke of paralysis, which would have confined a less resolute patient to his home.

For two or three years previous to his death the health of the deceased had been indifferent, and acting on the advice of his physician, in the summer of 1923, he went for an extended stay in England and on the Continent. It was during a fishing expedition in Scotland that he was suddenly stricken. After some months' recuperation in Edinburgh, he was sufficiently recovered to return to his country home in Llewellyn Park, West Orange, New Jersey. Here he showed such marked improvement as to encourage the hope of his recovery. But the stroke was mortal; and in spite of his courageous optimism, he sank gradually and passed away on April 3, 1924.

We can say of him, as we said at the time of the death of his father, that it was fitting that one whose name was to be so intimately associated with the work of fostering and chronicling the scientific and industrial development of his country, during the most notable period of its growth, should come of good American stock, whose beginnings are found in the stirring days of the early New England settlers. The first direct ancestor of the family to settle in America was Benjamin Munn, who in 1637 removed from Hartford, Connecticut, to Springfield, Massachusetts. Benjamin Munn, subsequently, was an active participant in the Pequot War, serving under the leadership of Captain John Mason. From him was descended Reuben Munn, who raised a company and marched to Cambridge at the time of the Lexington alarm call. Reuben Munn subsequently served under General Gates, during the remarkable campaign which resulted in the defeat and surrender of General Burgoyne at Saratoga. He finally rose to the rank of Lieutenant Colonel. Rice Munn, who was born in 1776 and died in 1866 was the grandfather of the subject of the present memorial. He is described as exemplifying the sterling qualities of the Puritan stock from which he was descended; upright and honest in his dealings; a true friend; a good father and husband; and a man of unusual ability. He married Lavinia Shaw.

Orson Desaix Munn, the younger son of that union, was born in Monson, Massachusetts, June 11, 1824. The story of Mr. Munn, from the year 1846 to the year 1907, is the story of the SCIENTIFIC AMERICAN for the first sixty-one years of its existence; for, after his education in Monson Academy and a brief business experience in his native town, Orson D. Munn, in the year 1846, was induced by his former schoolmate, Alfred Ely Beach, to take a step which determined both his future life residence and work. Young Mr. Beach, who at the time was employed on the staff of the *New York Sun*, which was owned by his father, Moses Y. Beach, had learned that a publication, known as the SCIENTIFIC AMERICAN, which had been started the previous year, was for sale, and the two young men purchased the property. A partnership was formed and the firm of Munn & Company established. The first issue under the new firm appeared on July 23, 1846.

In those days the SCIENTIFIC AMERICAN was the only journal in the United States devoted purely to science and mechanics, and it was inevitable that its office should become a place of gathering for the inventors of that day. Advice was sought and freely given, and this naturally led to the establishment of a patent department. The announcement of this policy, coming at a time when the profession of the patent lawyer was practically unknown, met with immediate response and marked the beginning of a practice which enlarged so rapidly as to necessitate the opening of an office at Washington. The patent business thus inaugurated ultimately grew to be the largest of its kind in existence. Among the noted inventors of those early days who foregathered at the office were such men as Captain John Ericsson, Commodore Edwin A. Stevens, Captain James B. Eads and Samuel F. B. Morse. Apart from the fact that this department, in the seventy-eight years of its life, has been concerned in the securing of some 200,000 patents, it has formed the school in which some of the most noted patent lawyers of the day received their training.

The next important step in the history of the firm was taken at the time of the Centennial Exposition of 1876, during which a supplement to the paper was published for the purpose of describing and illustrating the mass of interesting exhibits gathered in its various buildings. The success of the venture led to the continuance of the publication of the SCIENTIFIC AMERICAN Supplement as a weekly review of the scientific literature of the day. This was followed, a few years later, by the publication of *La America Cientifica*, which aimed to place the Spanish-speaking races of South America in touch with scientific and mechanical progress in the northern republic. Later, in 1885, prompted by the many requests for information on house building and furnishing, the firm brought out the Building Edition of the SCIENTIFIC AMERICAN, which proved so successful that in 1905 it was remodeled and published under the title of *American Homes and Gardens*.

The late Mr. Charles Allen Munn, after preparation in American and French schools, including three years in Paris, entered Princeton University, graduating in 1881. Subsequently, he graduated from the New York Law School and became a member of the New York Bar. He was also one of the charter members of the New York Patent Law Association.

In 1881, he entered the office of Munn and Company, and thereafter, until the time of his death, for a period of 43 years, he devoted himself closely to the interests of the parent paper and its affiliated publications and enterprises. Upon the death of his father he assumed control of the business, and it was under his presidency that it was decided to make the most momentous change in the history of the SCIENTIFIC AMERICAN, by bringing it out as a monthly instead of a weekly publication. The first issue under the new form appeared in November, 1921, and its enthusiastic reception by the subscribers proved that the change had been wisely made.

Mr. Munn was an enthusiastic sportsman, and in spite of his close attention to the interests of the firm, he found time for polo, golf, tennis and racquets. He was one of the founders of the Essex County Country Club, and Captain of its polo team. To those who knew him best it was evident that, outside of his business interests, the subject which lay nearest his heart was his collection of *Americana*, particularly his *Washingtonia*, which, thanks to his discriminating judgment and extensive purchasing, grew to be the most notable in the country. On this subject he was considered to be one of the foremost authorities, and his town house at 62 East 65th Street, New York City, contained several of the best known portraits of Washington by Gilbert Stuart, Trumbull, and Peale, the last named being a full-length portrait. The collection includes Wedgwood portrait cameos, mezzotints, miniatures, diaries, letters, etc., of Washington, Benjamin Franklin and many others of the founders of the Republic. Students and lovers of *Americana* will appreciate the fact that this unique collection was willed by Mr. Munn to the Metropolitan Museum of Art of New York.

Possessed of an attractive and forceful personality, and maintaining always an optimistic outlook on life, Mr. Munn gathered about him a large circle of friends, among whom his loss is greatly deplored. There was a side of his life, known only to his secretaries, for which he will long be remembered by many an unfortunate in the struggle for daily existence; for, underneath his brisk business exterior, lay a very sympathetic heart, and of the scores of supplicants for financial assistance that found their way to his office, it was very rarely that one was turned away. In addition to these secret benefactions, the story of which was unknown until his death, the fact that his name was to be found on a list of philanthropic, church, social betterment, and kindred societies, reveals a catholicity of spirit at once broad and generous.

In addition to the clubs already mentioned, Mr. Munn was a member of the University, Century, Grolier, Merchants, Union and Knickerbocker Clubs. He was also a member of the executive committee of the American Federation of Arts. He is succeeded as President by Mr. Orson D. Munn, grandson of the founder of the SCIENTIFIC AMERICAN, who will thus represent the third generation in the ownership of this publication.

With the Editors

SOMETIMES we employ this page to give you a taste of what is coming along in future issues; but another legitimate function which it must also serve is that of telling you something about the personalities that contribute toward making the current issue what it is. In the present case, Sir Oliver Lodge occupies the post of honor. An article from him on atomic physics is the strongest possible evidence of the SCIENTIFIC AMERICAN policy of going to the man who knows, for direct, first-hand, fully authoritative statements of the latest scientific advances. Sometimes this policy cannot be put into unadulterated execution; the man who is able to go into a laboratory and come out with a contribution to human knowledge is not always able to write about his own achievements in a way that shall make the best appeal to the layman. He may be the world's leading scientist, yet lack the sense of proportion that enables the successful writer to slide over the minutæ and spot the big outlines of the story. Or he may be, in plain English, a miserable writer—lots of perfectly intelligent workers in professional fields are just that; we know prominent doctors who can't write a decent letter. In such instances, the first-hand account that appears, nominally, under the signature of the great man has actually been prepared by a member of our own profession—one whose business it is to go out and get in contact with a story, absorb its essential features, and write about them sequentially and interestingly. But when we present an article by Sir Oliver Lodge, the world knows that no such intermediary has been at work, that the text is in Sir Oliver's own crisp, illuminating style, quite free of any journalistic tinkering.

SIR OLIVER does not exhaust the list of first-hand authorities who address you through the pages of this number. One of the leading research institutions of the country, so far as the solving of major industrial problems is concerned, is the Forest Products Laboratory, of Madison, Wis. Anything that you want to know about wood or wood products, the F. P. L. either knows or will find out. And from time to time, when they have completed a bit of research in which the procedure employed or the results attained are such as to be of general interest, we give them the space to put before our readers the first-hand statement of the man who has done the work. It may be Mr. Tiemann or it may be somebody else; but whoever it is, when the story carries the Forest Products Laboratory label, you may know it is by the man who did the work.

ANOTHER person who to the highest degree combines the power of advancing the cause of science with the ability to tell about it in proper proportion and in thoroughly interesting fashion, is Dr. Luckiesh. We suspect very strongly that he knows more about the practical application of light than anybody else in the world. And we have a very strong personal reaction toward him as well. He, as much as any person with whom we are acquainted, contradicts the old-fashioned idea of the old-fashioned scientist as the man with spectacles, long whiskers, an abstracted air and a complete detachment from the material things of the world. If he entered the room with an eminent lawyer, a successful bank president, or a prosperous hardware merchant, anybody who did not know him might be pardoned for surveying the pair and asking: "Well, which one is the scientist?" Perhaps one reason for the greater popular confidence in science today than yesterday, the greater willingness of the world of affairs to believe that the scientist is standing on both feet and has his head firmly attached to his shoulders, is the prevalence of scientists of the type so well represented by Dr. Luckiesh.

NO less vivid in the editorial mind is the personality of Dr. Gradenwitz, through whose efforts we have the important and absorbing article descriptive of Dr. Bruck's work. Dr. Gradenwitz more than any other of our friends represents the successful execution of a preconceived plan. Physically disqualified from the military or official career which automatically formed, before the war, the goal of every German of the educated classes, Dr. Gradenwitz entered the University with the deliberate intent of making a linguist of himself. How well he succeeded is testified by the fact that he contributes to so many different publications, in so many different tongues, that he finds it desirable to have several typewriters scattered about his study, in order that he may avoid the removal of semi-finished work in one language to make way for an emergency job in another. When we first called upon him, high up in the apartment house out in the Friedenau district, which he and the other tenants have to run themselves in lieu of the defaulting landlord, we found him pounding out correspondence in German on one machine, while a half-finished article which he was translating into English from a French original stood at attention in a second. The Doctor translates thus, or indulges in original composition if the circumstances admit of this, in and out of all the languages of western Europe—and perhaps some of those of the eastern half. And we know of nothing quite so typically German as the way in which, responding to a ring, he blares into the telephone transmitter, "Graa-a-a-a-denwitz!"

SPEAKING of German telephones—they have one little wrinkle, which, we opine, might be worthy of America's attention. Using the instrument at Zentral 6557, say, one desires to call Dr. Gradenwitz, at Rheingau 1308. When the operator at the Zentral exchange answers, one doesn't shoot the whole number at her, American style; one simply asks for the Rheingau exchange. That is, one enunciates the single word "Rheingau;" and in a moment one hears the same word repeated in one's ear, by way of notice that one has got Rheingau. One then asks for number 1308, without any prefix of course: and one gets it. With fewer repetitions of the number, it stands to reason there are fewer wrong connections given.

BUT one other vagary of the German 'phone we never did and never would get used to. Instead of giving the number by single digits, as we do, they give it in blocks of two. Thus 2578 would be "twenty-five, seventy-eight." Well, that's all very fine, until you start doing it in German; when it becomes "fünf-und-zwanzig, acht-und-siebzig"—in English, five-and-twenty, eight-and-seventy. There is a curious interlocking, turned-inside-out effect to this which must be experienced to be appreciated.

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SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

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Vol. 130, No. 5. Published monthly. Entered as second-class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

Price, 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year, postage prepaid.

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